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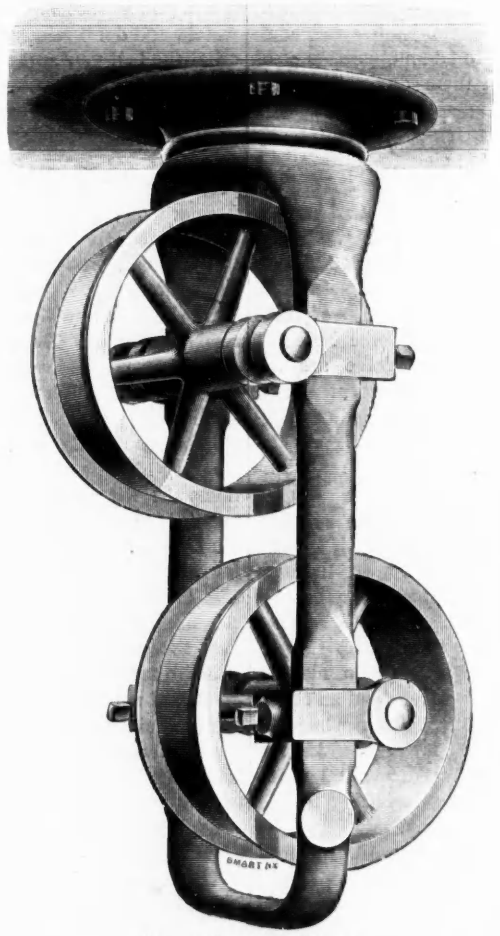
Frame for Guide Pulleys.

The accompanying illustration represents a frame for a pair of guide pulleys, which has recently been brought out by John Royle & Sons, Paterson, N. J.

It is designed for light belts; its neat and compact arrangement for adjusting the pulleys making it adaptable for places in which there is no room for a countershaft, and also for guiding a twisted belt, transmitting motion to a pulley placed at right angles, or any other angle, to the driver. The frame consists of two pieces—a disk and the frame proper. The illustration represents the disk fastened overhead; the frame proper is fastened to the disk by one bolt, whose nut is seen above the upper pulley; this manner of fastening the two, forms a swivel joint, so that the frame can be quickly adjusted to any line of belting. The bearings for the pulley shafts are simple clamps, formed like ordinary jaws; in these are inserted, between the shaft and frame, small, self-adjusting supplementary bearings. With this arrangement, the shafts can be quickly adjusted and clamped in any desired position. The provision for oiling is as follows: A small groove extending from one bearing to the other is planed in each shaft, and in the center of the groove a small oil hole is drilled through the shaft. The shafts are set with the grooves on top. The grooves are then supplied with oil in a way similar to supplying any ordinary oil hole; the pulleys working loosely on the shafts, cause the oil to be distributed along the latter.

The adaptability and extreme usefulness of these frames and guide pulleys were seen in Royle & Sons' shops, in which nearly all the work is finished to templates; for the convenience of handling quickly in drilling some of the small parts of machinery, and in the meantime leave room enough for the operators, so that they will not interfere with each other, four sensitive drill presses are placed closely with their backs toward each other, forming, so to speak, a cross. This arrangement of the drill presses left no room for countershafts overhead, yet with these frames and guide pulleys no difficulty was experienced in transmitting motion to the drill presses, and although four of these frames are used overhead, they did not appear to be crowded; in this arrangement twisted belts are used, some open and some crossed, the whole working very nicely.



GUIDE PULLEY FRAME.

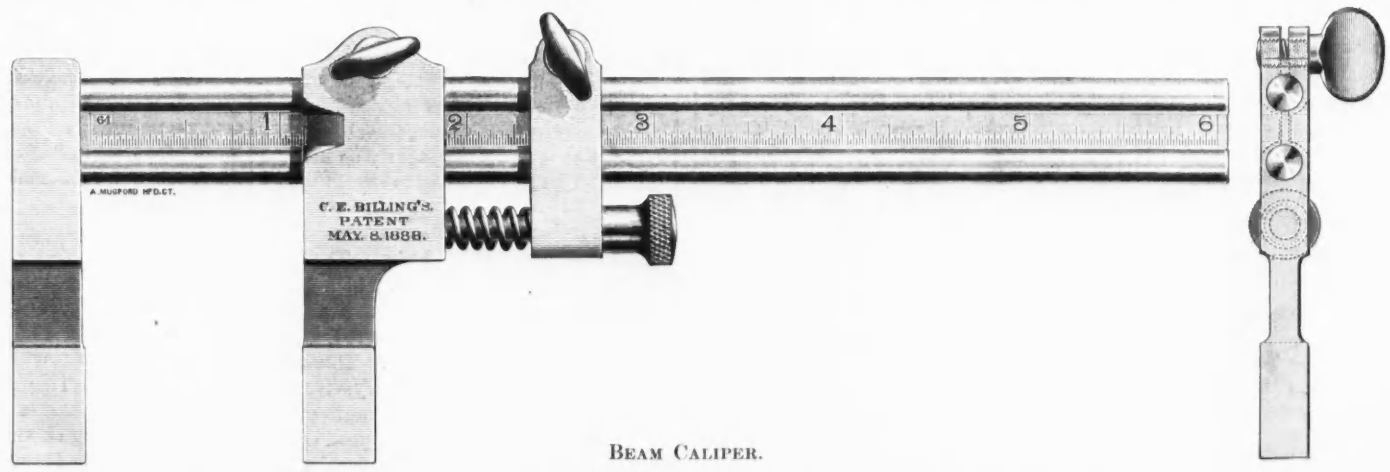
Weight of frame and pulleys is about 25 pounds; pulleys, 6 inches diameter, 2¼ inches between flanges, suitable for a 1 inch to 2 inch belt; total height of frame, 18 inches.

In 1888 the Suez Canal was traversed by 3,440 vessels of 7,640,832 tons, yielding to the company 65,102,000 francs in tolls, etc.

A New Beam Caliper.

The engraving accompanying this is of an improved slide gauge, devised by Mr. C. E. Billings, of the Billings & Spencer Co. It is similar to other tools of its class, except in the construction of the beam, in which a radical departure has been made, with the result of securing what appear to be important advantages. The beam is made of three pieces, two of which are pieces of steel wire about $\frac{3}{16}$" diameter. Along this wire, grooves are milled, to closely fit the edge of a steel scale, which is inserted and brazed into them, the work being done in such a manner that the wires are straight and parallel to each other. The sliding jaw, adjusting clamp and fixed head are each drilled and reamed to fit over the wires, the slots in the first two named pieces being made sufficiently wide to clear the scale, so that little wear takes place, and the bearing when the sliding heads are clamped is confined to the wires. All abrasion of the scale is thus prevented, and the character of the bearing is such that there is the minimum tendency to throw the jaw out of square with the beam, as a result of wear. At the same time the form of the beam gives the greatest rigidity and strength with a given weight. The jaws are hardened and accurately ground, and it is the intention to make some of the tools with a micrometer head on the adjusting screw, by which the sliding jaw can be moved by thousandths of inches.

They are made by the company named above, at Hartford, Conn.



BEAM CALIPER.

From London to Paris.

Editorial Correspondence.

So far I have said nothing of the reception of the American engineers by the Institution of Civil Engineers, acting for themselves and the various bodies of engineers of the United Kingdom. This has not been because there was nothing to say, but because it is quite impossible to do anything like justice to the subject. Let the reader imagine three hundred or more Americans taken in hand by British friends, entertainments, dinners, and receptions arranged for their pleasure and benefit, excursions by rail, steamers and carriages to places of interest; this kept up for two weeks, with the rooms of the institution constantly open for the use of their guests, the members devoting their time to their visitors—and he will have a faint idea of what it is impossible to put into cold, unfeeling type. I do not believe anything approaching this reception and entertainment was ever seen before.

It would not be in the nature of justice to mention British engineers only in connection with the entertainment of the American engineers. Her most gracious majesty, the Queen, gave special permission for a visit to Windsor Castle and royal domains in London, and the authorities of London placed at the disposal of the reception committee the use of the ancient Guild Hall, where the visitors were entertained at a festival dinner, according to old English custom. Then the railway companies vied with each other in offering free transportation, special trains and other courtesies.

Every American engineer who was present during the stay in England knows more than he will ever be able to tell of the successful efforts of British engineers and citizens to entertain him. If the events were all written out in detail, there would still be lacking the spirit in which it was all done. Not content with escorting their visitors to the steamboat at Dover, this spirit pursued them to Paris, and found expression in a reception and entertainment in the rooms of the British Commission on the exposition grounds.

The disposal of sewage in London, as in most large cities, is a question of great importance, and the American engineers were interested in a visit to two sewage disposal works, one at Wimbledon and the other at Kingston-on-Thames. At Wimbledon the district dealt with contains from 30,000 to 40,000 inhabitants, and there is a fine farm under cultivation. Presses are first used (a disinfectant being, of course, employed,) for pressing into thin cakes the solid matter in the sewage, then the liquid is used for irrigating the soil, passing from one field to another, till finally, when it enters the river, it looks as clear as a mountain stream. The presses are quite large affairs, horizontally situated, and are made up of a series of seperable compartments, the arrangement being such that the liquid passes through textile strainers while the solid matter is detained in these chambers and pressed into large, square cakes, perhaps five-eighths of an inch thick. After the pressing is finished a car is run under the press, the sections separated, and these cakes drop into the car, breaking up as they fall. This is then worked over and sold as a fertilizer. An air-compresser is used for obtaining pressure, and the necessary pumps for elevating the sewage are employed.

At Kingston, where the sewage is from a district numerically of about the same size as that at Wimbledon, the treatment is different. A chemical process is employed, which consists in part of treating the sewage with carbon and with alum as a precipitant. After the alum treatment the sewage passes through a series of settling tanks, growing gradually clearer, till it finally reaches the Thames in a condition that looks quite harmless; it is said to be entirely so.

Considerable information was had in regard to the operation of the London Hydraulic Power Company. This company, as the reader already knows, was established

for the purpose of furnishing water under high pressure to operate lifts, elevators, presses, etc., by direct application, and to run machinery of any kind by means of engines furnished by the company. There are upwards of thirty-five miles of the company's mains in London, and new mains are being laid as required. These mains are of cast-iron, from two to seven inches diameter; flanged joints and rubber packing being used. Pumping engines in different parts of the city charge the mains, and there are large accumulators in which a pressure of 750 lbs. per square inch is maintained. In some instances the water is pumped direct from the river, in others from the gravel stratum overlying the clay. In either case the water is filtered before entering the mains. That pumped from the gravel contains a large quantity of iron, and is chemically treated before being filtered.

London appears to have been slow in adopting electric lighting. In public places where one would expect to see electricity rivaling sunlight, gas is yet supreme. But if the people of London have been slow in taking up the electric light, there is abundant evidence that they do not lack boldness when it comes to the question of preparing to supply it. One of the best evidences of this is to be seen at the station now being constructed by the London Electric Light Corporation. The plant is to be an enormous one, and the buildings are of the most substantial character. But what takes one's breath away is a contemplation of the fact that the company is having constructed four dynamos, each of which will require 10,000 horse-power to drive it to its full capacity. There are also being constructed the engines to drive, by direct connection, these huge dynamos. Each dynamo will require a pair of engines, each engine of 5,000 horse-power; they are to be two-cylinder tandem compound vertical engines, with Corliss valve gear; cylinders 44 inches and 88 inches diameter, with 4½-foot stroke. The engines (and dynamos) are to run at about 70 revolutions. These dynamos will, at full power, supply 200,000 lights. What a territory would be left in temporary inside darkness if something should befall engines or dynamo. And a break-down would be likely to be such an one as could not be repaired in a day or two. But I suppose the matter has been well weighed, and perhaps a surplus of 10,000 horse-power is not looked upon as of much consequence; certainly there must be such a surplus that putting out of commission for a month or two the means of operating 200,000 lights will not result in inconvenincing consumers. Either this, or the inhabitants of London are not given to complaining.

The idea of such an enormous concentration of power it must be admitted, did not strike most American engineers favorably; but then London is a good deal larger than the largest American city, and money is more than abundant. The shafts of both engines and dynamo will be of hollow steel, the practice of using such shafts being very common in England.

The company has already in place two 1,500 horse-power two-cylinder side-by-side vertical compounds, and has nearly completed corresponding dynamos. Upon the first floor of the plant there is provision for 48 Babcock & Wilcox boilers, most of which are in place. The second floor is not yet completed, but provision will be made for placing on that floor 48 more boilers, directly over the others, making 96 in all. There will also be room on this floor for storing 4,000 tons of coal.

There are already several tools in the company's workshop, notably a large planer built by Thomas Shanks & Sons, Scotland. This last named firm are also erecting another planer at the works—a side planer—the weight of which is 96 tons. It will plane a piece 20x22 feet. The work on these tools appears to be excellent. The reason for putting in these large tools is one seldom thought of in America. It is mainly because, if England were to become engaged in war, such large tools in all shops would be used for Government work, and it would be impossible to get any other work done that required their service. As one piece in the 200,000 light dynamo weighs 50 tons, it will be concluded that there would not be an abundance of planers in the kingdom that would handle it. Traveling cranes on the plant are of a capacity sufficient to handle this piece. It may be noted that an engine is attached to these large dynamos, and so arranged as to help in separating the parts in case inspection or repairs are necessary.

In traveling from London to Dover—on the way to Paris—I had further opportunity to note railroading in England, and saw no occasion to reverse my previously expressed opinion. The running time—the distance is 78½ miles—is at the rate of 45 miles per hour, and this time is made. It appears as though 45 miles was a very common speed in England, and on a run of only 78 miles, and getting out of a large city like London and passing through large towns, it is good time. The car I rode in was called a smoking car—they have various patterns of smoking cars in England. It had seats on the sides and ends, and in the center two long tables that could be used for reading or writing.

Officials of the road—The London, Chatham & Dover—accompanied the engineers to Dover, and I had an opportunity of talking with one of them during the trip. This road has been expending a good deal of money in the way of getting the permanent way and rolling stock in first-class condition. The passage from London to Paris, in connection with the Northern of France Railway, is made by some of the trains in 7½ hours. The official to whom I refer pointed out to me the various branches of the main line, and explained their purpose. Some of these have only prospective use in case England becomes engaged in war. These are the branches leading to the Government docks, which might be, in the event named, serviceable in transporting war material. As the gentleman explained, England maintains peace by being prepared for war.

Passing through Kent my informant remarked that the mean level of the ground had been lowered about six feet, the material having gone to London in the form of brick. He pointed out one tract, the owner of which received $2,000 per acre for the privilege of removing the clay for making brick; then after this was removed an excellent bed of gravel was found, for which he received another $2,000 an acre. As the top soil is removed and saved, he still had his land intact, except that it was located a little nearer the center of the earth.

He pointed out a location not far from London, where there was no apparent lack of land, and through which the company was desirous of building a branch road four miles long. The necessary land would cost $600,000, or, as I mentally estimated it, about $8,000 an acre. Its nearness to London gave it this prospective if not immediate value.

I noticed the telegraph wires along the road were within reach of the ground, and inquiring the reason, found that storms of moist snow and rain often clogged and crossed the wires, and that placing them near the ground served in a great measure to protect them. Presumably they were also more readily cleaned. As there is rigid law against trespassing on railroad property, the small boy and the evil disposed are not as great factors in the case as they would be in the United States.

The London, Chatham & Dover Co. has three new, powerful, side-wheel steamers, which are run from Dover to Calais, in connection with their trains, making the passage—22 miles—in from sixty to seventy minutes. Side-wheelers of shallow draft are used, on account of the lack of water at Calais, except at high tide. These steamers—which are not large boats—have engines said to be capable of developing 5,000 horse-power. The one that took the engineers across has two-cylinder compound engines, the upper cylinder—the high-pressure one—lying horizontally, with the lower one—which is below and a little to one side—inclined upwards, getting hold of its crank-pin as near the high-pressure pin as is consistent with making the crank throws of proper strength. The cranks are at right angles, and the link motion is employed. It is a remarkably compact engine, and seems exactly adapted to the purpose.

From Calais the run to Paris was over the Northern of France Railway, giving an opportunity to note railroading in France. This ride, and some others since, leave the impression that as much importance is not attached to fast running in France as in England. There is a good deal of courtesy connected with the operation of getting a train over the road, the usual requests of conductors or guards—I am not just sure what they call them—ending with if you please, the expression for which in French is common enough in America not to be mistaken, though one's knowledge of French may be a thing of the past. When the train stops at a station the time of the stop is announced, and you catch on to enough to understand that it is for, say five minutes. You get out of your compartment—the cars are very much like those on English roads—wander away for about a minute, and are recalled by the sharp ringing of a bell. When you get accustomed you look at your watch, and don't mind the bell. If you do mind the bell you hurry back to the car and sit there for three or four minutes, which you always think you might have used to better purpose. Finally, when the guards are quite sure their passengers are all safely in their proper compartments, the word to that effect is passed along from the rear coaches, until finally a whistle conveys the information to the engineer, who proceeds to act upon the suggestion.

One sees many things to like on the railroads in France. Every one is exceedingly good-natured, and every one is polite. When the guard is desirous of communicating something he walks along outside the car, for all the world like an American engineman working his way along the running board, raises the window of the compartment and makes his request known.

At the beginning and conclusion of your journey porters are at hand to attend to your needs, the same as on English roads. The cars are very much the same as in England, but, as said before, there is not so much effort to make quick time. The whistle is a good deal used on French roads, but it is a small affair, and emits a sound only a little more intense than that of the whistle on the low-water alarms used in America. And even at that, when you hear it you are impressed with the idea that the engineer is sure of his water.

The coaches for the short runs out of Paris, as to Versailles and other places of popular resort—what we should call excursion trains—are double-deckers, like the omnibuses and street cars in Paris. That is, there are seats on top of the cars; and these seats, in fair weather, are the ones sure to be first filled, whether it be on these excursion trains, on omnibuses or on street cars. In pleasant weather all Paris lives and moves out-doors as much as possible. And on cars or omnibusses there is no crowding allowed as in America. When the vehicle is full, whatever it is, there is no more hope of getting on; you must wait for the next.

Some distance from Calais, towards Paris, the train was stopped for nearly an hour to permit the visiting engineers to see the operation of a hydraulic lift on a canal. This lift serves the same purpose that would be served by a number of locks. The boat enters a suitable compartment, which is attached to a ram about six feet—at a guess—in diameter, and is raised or lowered, as the case may be, to the other level. The work of this lift—especially the masonry—is excellent, and it is a fine example of engineering. The people of France are taking good care—and wisely so—of their excellent canals.

I want again to disclaim any intention of making unfair comparisons between railway management in the United States and railway management in England and France. I have simply tried to set down things as I see them, without prejudice. If I have prejudice—as I suppose all have—it is certainly a prejudice that leans towards the United States. While I like the democratic tendency of railroad travel there—every one on a level, as it were—I do not see anything to complain of in either England or France. It is certain that such crowding of cars as is permitted in the United States would not be tolerated in either of the other countries named, and the incivility often seen in petty railway officials in the United States would insure their instantaneous dismissal here. I like the long, heavy trains run in America, but so far I better like the practice here of stopping when there are cars enough behind the engine. I like the apparently moderate way of getting started to do a thing, especially noticeable in railroading in France. Bustle and confusion, and trains too heavy to make time with, have nothing to do with making haste. It has been the fashion with Americans to find fault with European railroad traveling, and this has had the effect to prevent improvements in our own methods of traveling. If there are things in our system that are better than in Europe, it is equally certain that in both England and France there are things that might be copied in America to the safety and comfort of the traveling public. H.

Smoke from Soft Coal.

It is quite a matter of belief amongst many educated people that smoke from soft coal may have certain beneficial sanitary effects.

For example, the sulphur in the coal, be it hard or soft coal, burns to sulphurous acid gas, a well known disinfectant. In addition to disinfecting by destroying germs, this gas has the power of disinfecting the color of curtains and other fabrics; it disinfects the tints of fine paintings, and generally makes its properties apparent by changing the appearance of everything with which it comes in contact. Combined with the moisture of rain it forms sulphuric acid and acts as a solvent of iron railroad bridges unless these are well painted.

No amount of care in combustion will remove the sulphurous fumes from smoke. They may be washed out by water sprays.

A further product of bituminous coal is creosote and its allied products. One of these, carbolic acid, has great powers of disinfection, and there appears good reason to believe that an atmosphere thickly charged with soft coal smoke may be freer from germs of disease than an otherwise purer air.

In England, where soft coal is all but universal, the fuel is very smoky—not perhaps so smoky as western coal, but still very sooty unless properly burned to water and carbon dioxide, and not distilled to hydrocarbons and phenol.

To the American engineers lately visiting England it appeared a matter of regret that the solid carbon or soot of the soft coals should so seriously disfigure the many beautiful and old buildings of London and other cities, and it is a matter of regret that black smoke is produced in such great volumes when it may be prevented by proper care and precautions.

The chief annoyance from soft coal arises in damp climates where there is a mist. On such occasions the smoke which will not rise in a misty atmosphere simply collects at the ground level and produces a fog. If soft coal were universal in New York City, the black fogs which would be produced on misty days would rival those of London. Black fog is not a natural product. A London black fog becomes a light white mist just outside the city. To prevent these fogs in New York or any other city with a damp atmosphere, soft coal requires to be burned, not distilled.

We note that Thomas A. Edison has recently been granted a number of patents, ten of them being announced in the *Patent Office Gazette* of July 9. This is a good many, considering the fact that an interview with him was published not long ago, the burden of which was that the Patent Office was of little or no advantage to inventors nowadays, and, unless our memory deceives us, announcing that he should have little or nothing to do with it in the future. The fact is that, though much fault is found with our Patent Office by inventors—perhaps justly so—nevertheless, patents granted by it form the basis of many very large fortunes.

Modern Locomotive Construction.

BY J. G. A. MEYER.

NINETY-SIXTH PAPER.

We have already seen that the design of the throttle valve gear shown in Figs. 525, 526 (94th paper) is used on engines whose boilers extend nearly to the rear end of the cab. This class of engines, or the class of engines in which the throttle rod passes through the side of dome, generally present first-class opportunities for making provisions for attaching the various kinds of valves and cocks without screwing each one directly into the boiler shell. Consequently in many of the locomotives of these classes built in recent years, we find a throttle valve gear like that shown in Figs. 536, 537, or others, very similar in design to the one here shown. In these illustrations we have only represented the most prominent features of this design of throttle valve gear; for the sake of simplicity the throttle lever, with its attachments for locking it, is not shown; in fact, any one of the throttle levers previously illustrated, with only a slight modification in a few of them, can be used in this kind of gear. The principal feature in this design is the steam stand *B*, which is simply a rectangular box, generally made of brass. In Fig. 536 we see a longitudinal section of this box, and Fig. 540 shows a cross-section of the same. These figures plainly indicate that this steam stand *B* is divided into two compartments or chambers, *D* and *C*; the chamber *C* nearly surrounds the chamber *D*. Communication between these two chambers is either opened or closed by means of the valve *e*.

The throttle rod *H* passes through the chamber *D*, and also through the heavy wrought-iron pipe *E*; the latter forms a connection between the steam stand *B* and the dome *G*. The rear end of steam stand is bored out so as to form a stuffing-box; and *h* is the stuffing-box gland. The end *i* of the throttle rod *H* is fastened to the throttle jaw (not shown here), and this throttle jaw connects to the throttle lever.

The steam pipe *E* is connected to the dome by means of a thimble *K*, which takes the place of the brass flange described in the ninety-fourth paper. A part of the outer portion of this thimble is hexagonal in form, its remaining outer portion being threaded and screwed into the dome sheet. A portion of this thimble is tapped and receives the threaded end of the pipe *E*. This is a favorite way, in locomotive practice, of connecting a pipe, of the kind here shown, to the boiler. On the other end of the pipe *E* a wrought-iron sleeve *f* is screwed. A separate view of this sleeve is shown in Fig. 543, and, as will be seen, it forms a ball joint with the steam stand; this sleeve is held against the stand by the flange *F*, of which a separate view is shown in Fig. 542.

Fig. 537 represents a plan of the steam stand *B*; here it is plainly seen that the sides of this stand have a number of tapped holes; into these, the various valves and cocks are to be screwed, which otherwise would have to be screwed into the shell of the boiler. For instance, the holes *a a* receive the injector valves; *b*, *b* receive the cylinder oil cups; *c* receives the blower valve; and *s* the steam gauge cock; the hole *d* on top of the stand takes the brake valve.

Steam is conveyed from the dome through the pipe *E*, and enters the chamber *D* in the steam stand, and when the valve *e* is open the steam enters the chamber *C*, and supplies all the valves attached to the steam stand.

Fig. 541 shows the spindle of the valve *e* on a larger scale; Fig. 538 shows the front end of the steam stand *B*, and a portion of the steam gauge stand *A*; Fig. 539 shows the rear end of the stand *B*, with stuffing-box gland *h*; the tapped hole *g* receives the fulcrum for the throttle lever. In Fig. 536, *S* is the steam gauge; and *L* the steam gauge lamp.

We believe this arrangement to be one of the best and neatest in use. All the holes in the steam stand *B* can, of course, be drilled in a machine, and all the valves, etc., fitted in it before it is taken into the erecting shop, and, therefore, less time and labor will be required for attaching the different valves, cocks, etc., to the engine, than must be expended when each one of the valves has to be fitted directly into the boiler shell. But besides this advantage, the steam stand possesses another one, namely, with the valve *e*, the steam is at once shut off from all the valves attached to the stand, consequently, if one of these valves gets out of order, it can be repaired with full steam pressure in the boiler.

The relative position of the steam stand *B* will greatly depend upon the position of the reverse lever; it must be placed in a position which will bring the throttle valve lever, and also the reverse lever, within easy reach of the engineer; consequently we often find that this design of throttle valve gear is placed quite a distance in front of the back head of the boiler, and differs from the position generally assigned to the throttle valve gear in ordinary eight-wheeled passenger engines. In fact, in the latter class of engines the boiler seldom extends more than 12 to 15 inches into the cab; hence, the steam stand illustrated in Figs. 536, 537 is not suitable for this class of engines, because there is no room for it. The short extension of the boiler into the cab, and general design of passenger engines, necessitate the use of throttle valve gears, such as have been illustrated in Figs. 514, 517, 519. When one of these throttle valve gears has to be used, the steam gauge stand becomes an independent fixture, and, for the sake of convenience to the engineer, the steam gauge stand is generally fastened to the curved part of the back head of the boiler.

Fig. 544 represents a steam gauge stand for passenger engines or that class of engines whose boiler projects but little into the cab. This stand is arranged for a steam gauge and clock, the latter being placed above the former. In this figure we also see an outside view of the spring balance *S* connected to the lever *C*. The rod *E* extends upwards and is connected to the safety valve lever. A portion of the lever *C* is represented in section, so as to show the spiral spring underneath the pawl *D*. The spiral spring keeps the pawl engaged with the circular rack *e*, and prevents the lever *C* from being pulled upwards by the tension of the spring balance. The lever *C* swings on the pivot *f*, which is cast to the steam gauge stand; hence in pulling the lever *C* downwards the tension of the spring will be increased, and therefore the force which presses the safety valve against the seat will also be increased. Pressing the pawl *D* towards lever *C* disengages the pawl and rack, allowing the lever to move upwards, thus enabling the engineer to blow off steam when necessary.

Another view of the pawl is shown at D_2. The nuts *g g* fasten the steam gauge lamp to the stand. Fig. 545 represents a plan of the lever *C*, and a section of the steam gauge stand.

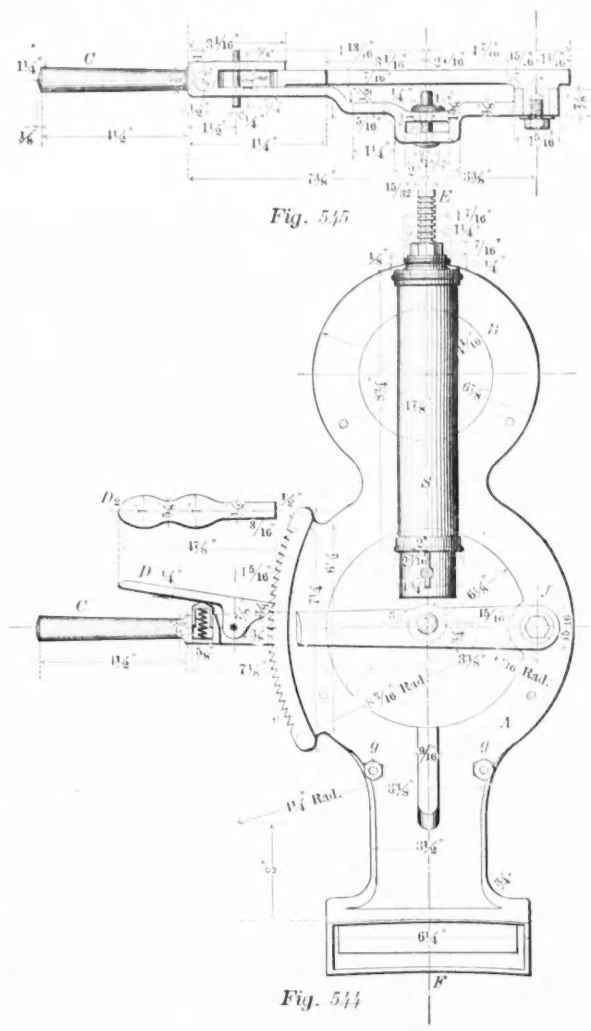


Fig. 544

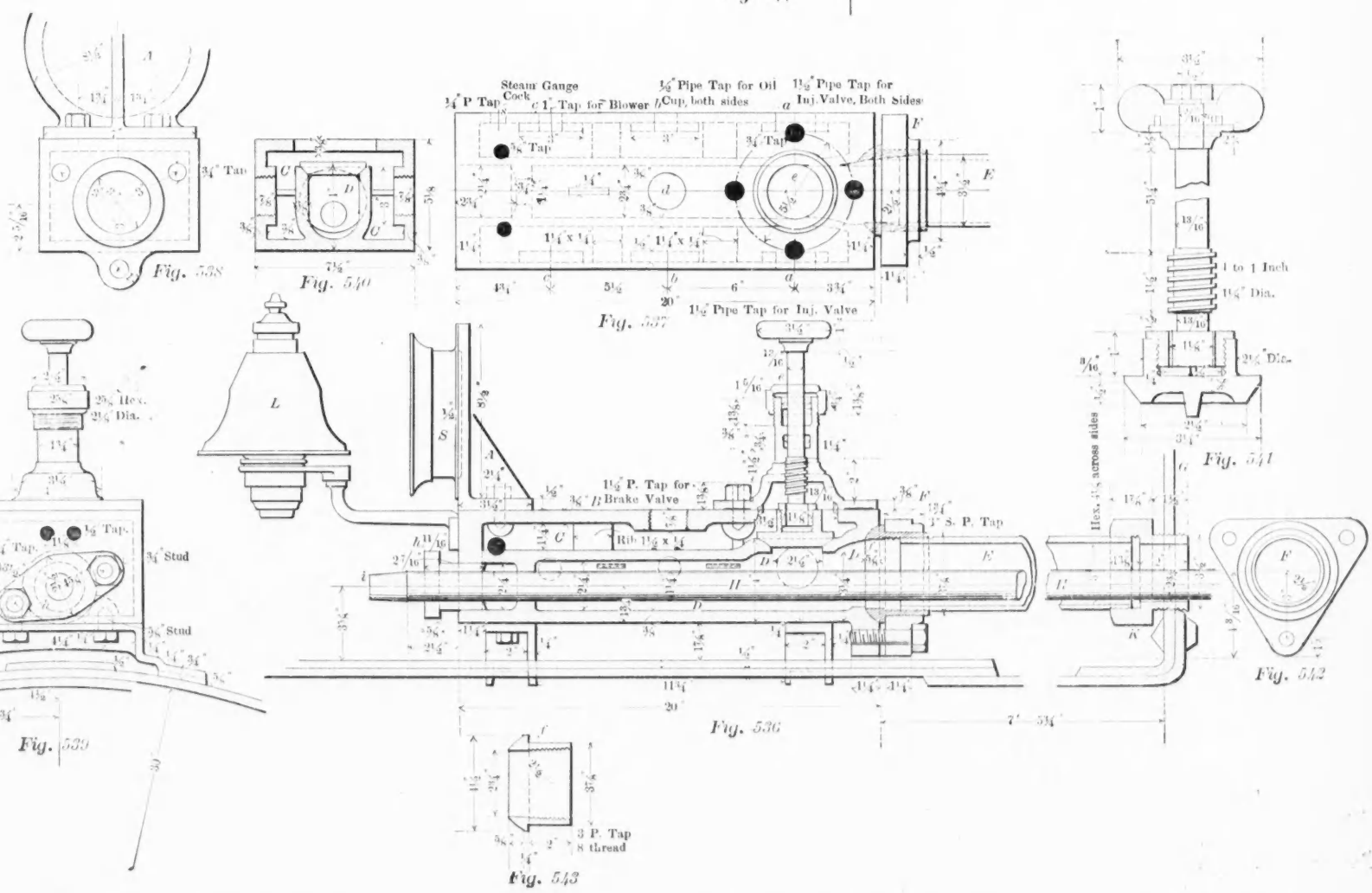


Fig. 538 — Fig. 540 — Fig. 537 — Fig. 541 — Fig. 542 — Fig. 539 — Fig. 536 — Fig. 543

Foundry Ladles.

BY ROBERT E. MASTERS.

Fig. 1 is a five-ton crane ladle, the sides of which are of $\frac{1}{4}''$ boiler iron, and $\frac{3}{8}''$ iron in the bottom. The bail *A* has a bar across it above *B* to brace and keep it in position when lifting this mass of iron. The bearing *C* for the worm *D* is riveted fast to the bail. The ladle is turned by the hand wheel *E*, which has a wrought stem and socket *F* to fit over the square end of the worm shaft. The hand wheel and shank are kept off so they will not be in the way until ready to lift the ladle to pour.

In some foundries they use only a part of a gear wheel *G*, in others they have the whole gear. I have known a gear for this style of ladle to be stopped off in the mould to just the size required to turn the ladle, when there could have been no objection of the extra weight throwing the ladle out of balance or of the crane handling it. The square end of the trunnion *H* is for the sockets of the shanks and handles. It is a good plan to have a small chain and pin fast to the shanks near the sockets, the pin to go through a hole in the socket and *H* to prevent the handles coming off and losing control of the ladle when pouring a large piece. The bands *I* are riveted or bolted on. The wrought-iron straps *J* for supporting the bottom are put on in a variety of ways, forming a circle or oval underneath the ladle they are bolted (*K K*) to the straps that are suspended from the trunnions. In some instances a wrought-iron cross, Fig. 2, is put on the bottom, and flat bars bent to hook over the top of the band and bolted to it at *L*, with the other end of the bar forged round, a thread cut on it, and bolted fast through the holes in the end of the cross *M;* these bars are put on quartering with the trunnions.

Angle irons $3'' \times 3''$ and $\frac{1}{2}''$ thick, bolted to the ladle in four places under the band at *N*, are a good thing. I have seen these angle irons bolted to the ladle above and beneath the band.

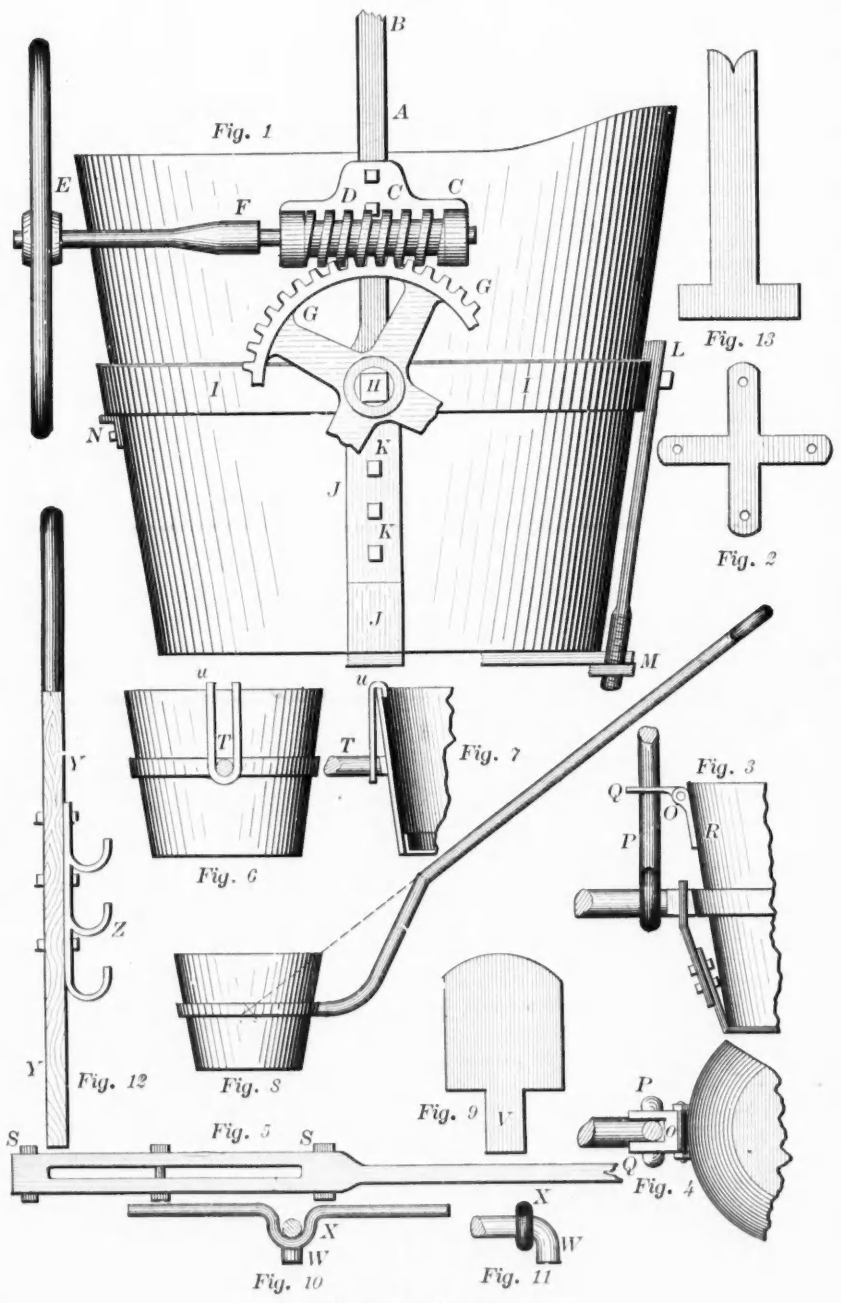
Figs. 3 and 4 show a side and plan view of a safety lock *O* used on the bail of ladles to keep them from turning when lifting to a high mould; they are especially good on top-heavy ladles. When the bail *P* is put on to lift the ladle, the catch or lock *Q*, which is on a hinge and rests on the edge of the ladle when not in use, is turned back on the bail, as seen, until the ladle is in position to pour, when it is relieved from the bail. It is riveted to the ladle at *R*.

I have seen large ladles with such poor arrangements to handle them, or so much out of balance, that long levers like Fig. 5 were slipped over both the handles. *S S* are bolts to keep the wood from splitting, the center bolt is to keep the lever from slipping entirely off the handles onto the shank. When ready to pour, if the ladle does not turn easy for the men on the handles, the man who has hold of the end of the lever helps start it or holds back if it starts too fast.

Ladles are often battered and bent out of shape by driving wedges and pieces of iron in between the band and the ladle to keep it from falling out when pouring. This is because no provision has been made to keep the ladle in its place and make it safe to pour with. I refer now to ladles that are carried by the men, commonly called "Bull ladles," and holding from 100 to 300 pounds of iron. It is no uncommon occurrence for one of these loose ladles to fall out of the bail into the receiving ladles in front of the cupola when pouring back what iron is left to keep it from "setting," while waiting for the next turn; then there is a pretty mess and a time in trying to get it out again; perhaps it makes a ladle short on the heat and everything works so charmingly that the men go home in a delightful (?) humor with the way the heat went off, and do some scheming the next day to avoid getting "that blank ladle." Figs. 6 and 7 are side elevation and section views of a plan practiced to secure the ladles in the band when they are not bolted, riveted or fastened with angle irons. Part of the shank *T* is shown with a piece of round wrought-iron bent around it and hooked over the edge of the ladle at *U*. It takes but very little time or expense to secure a ladle in this way.

On account of the shape of the hand ladle shanks in many foundries the men have to walk humped up like a camel to keep the iron from spilling on the floor, and they have to carry the ladle in front of them, to see that it is kept level, instead of being able to watch where they are stepping, and if a misstep is made the man is right into the iron, and even if he gets safely to his floor it is an awkward job to pour the moulds.

Fig. 8 is a hand ladle shank that enables the moulder to walk in a more natural position, with the ladle carried level at the side and to the rear, and it is an easy matter to guide the stream when pouring. It will be noticed the ladle has a flat bottom. If from any cause it is necessary to set it down for a few moments on the floor or corner of a flask,



FOUNDRY LADLES.

and the shank drops down off the ladle, there is not the danger of it tipping over and laying a man up with burnt feet, as is often the case when using round bottom ladles. Like the old adage about the tub, I believe every ladle should stand on its own bottom. Fig. 9 is to shield the hand when carrying this ladle; it is made of sheet iron, bent to suit the circle of the ladle; the stem *V* is put between the ladle and hand.

Figs. 10 and 11 are two views of a carrying bar for two men on the straight end of a "Bull ladle" shank; *W* shows a hook turned on the end of the shank to keep the bar *X* from slipping off. They are of 1" round iron, and are more convenient and safe than wood.

Fig. 12 is a rest for the shank of a ladle when pouring. They can be used on both sides of the ladle, and they relieve the men a great deal if they have to hold up about 300 pounds of iron. The standard *Y* is a $1\frac{1}{2}'' \times 2\frac{1}{2}''$ strip of wood. The ladle can be rested at a height to suit in the hooks *Z;* these hooks are in one piece of cast-iron, and are similar to the brackets used to support steam pipes; in fact, the one shown was made from a steam pipe bracket pattern. There are several kinds of rests used, among which, Fig. 13, of wood, is the most common.

English Boiler Inspection.

BY W. H. BOOTH.

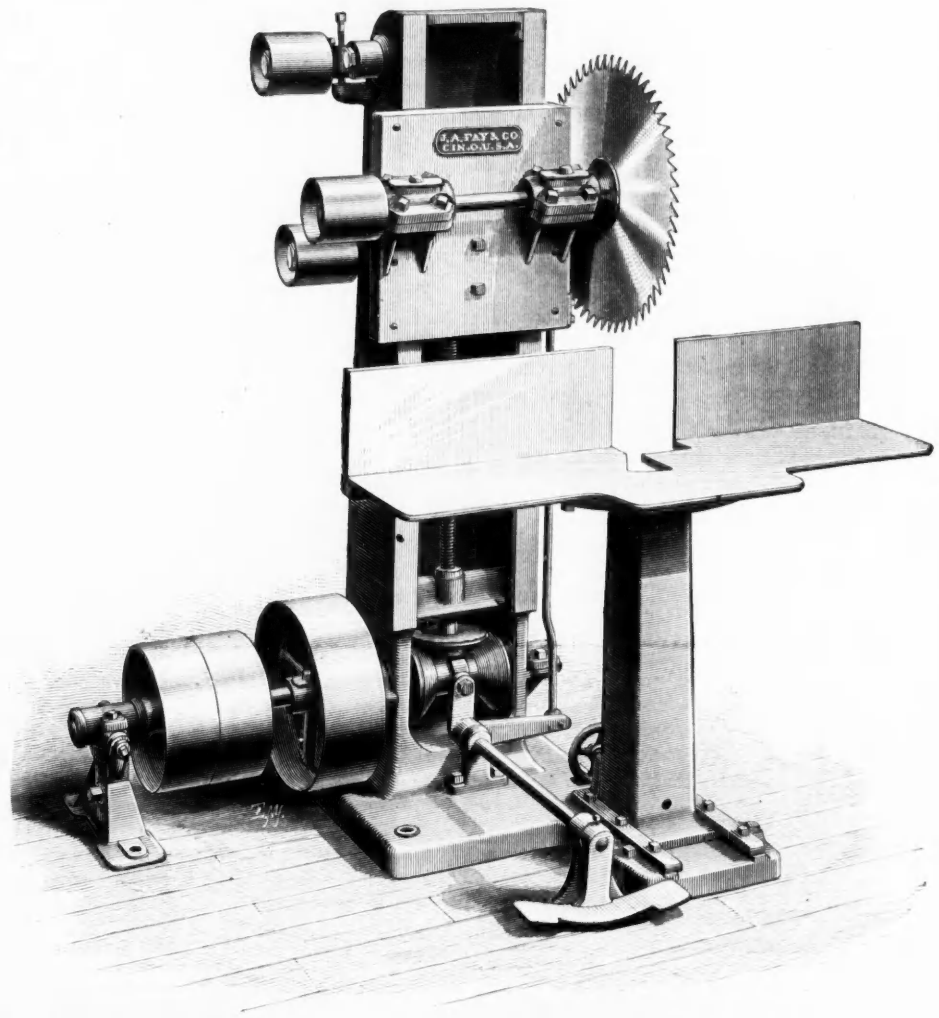
Apart from the faults in construction and of corrosion arising from constructive causes, to which we have already referred under the head of grooving, there are numerous faults of surrounding and of fittings to which attention may well be here drawn. Of all mountings attached to a steam boiler, the safety valve, nominally so called, has been productive of the most frequent disaster. Such disasters have been due not altogether to the faults in the construction of the safety valves themselves, but partly to the faultiness of their connections. The plain, open topped valves from which the escaping steam passes directly to the atmosphere, is usually fairly safe, but when boilers came to be more usually under cover or placed in workrooms, the open topped valve became an infolerable annoyance and could not be well employed. As a remedy, the valve was placed in a close box, through the cover of which the spindle bearing on the valve passed to the weight lever above. Quite commonly the hole in the cover would be fitted with a stuffing box and gland, and when not so fitted the spindle would be a good sliding fit. From the closed box an escape pipe for the steam is carried to the open air, or even to a drain. Now experience and inspection have shown that frequently this escape pipe is carried to a point where it can be seen by no one interested in the working of the boiler. Such a point of discharge may be a drain or sewer, as above named. It may be the interior of an archway over a neighboring stream, or it may be simply some point at the side or rear of the boiler house. Wherever it might be, its invisibility would be a constant source of danger, and especially in the event of an inoperative pressure guage the liability of the closed safety valve to cause accident, or to contribute to it, more properly speaking, is very great. In some cases during frosty weather the freezing up of the escape pipe has sealed the valve entirely. This is especially liable to occur when the escape pipe has an upturned end in which ice can more readily be formed than in the directly open pipe. In other cases of accident, corrosion of the valve spindle in the cover, or undue tightness of the gland when one has been present, have been traced as causes of disaster. Various circumstances, climatic or otherwise, will determine whether an escape pipe should slope to or from the safety valve, and in any case drain pipes should always be inserted at the lowest points, to draw off any water condensed in the pipe. In cold weather special attention should always be given to a closed safety valve and the daily test of its actual working should be oftener than the once or twice thought sufficient in ordinary weather. As the result of experience it is laid down as a rule that, while the working safety valve of a boiler may be of the closed type, it should invariably be supplemented by another valve of the open topped type. This supplementary valve may, for avoidance of the inconvenience of its blowing in a closed room, be fairly loaded to five pounds in excess of the working valve. In event of the working valve ceasing to act, the open valve becomes operative and draws prompt attention to the inaction of the former. To insure safety, the same daily testing of the open valve should be carefully made.

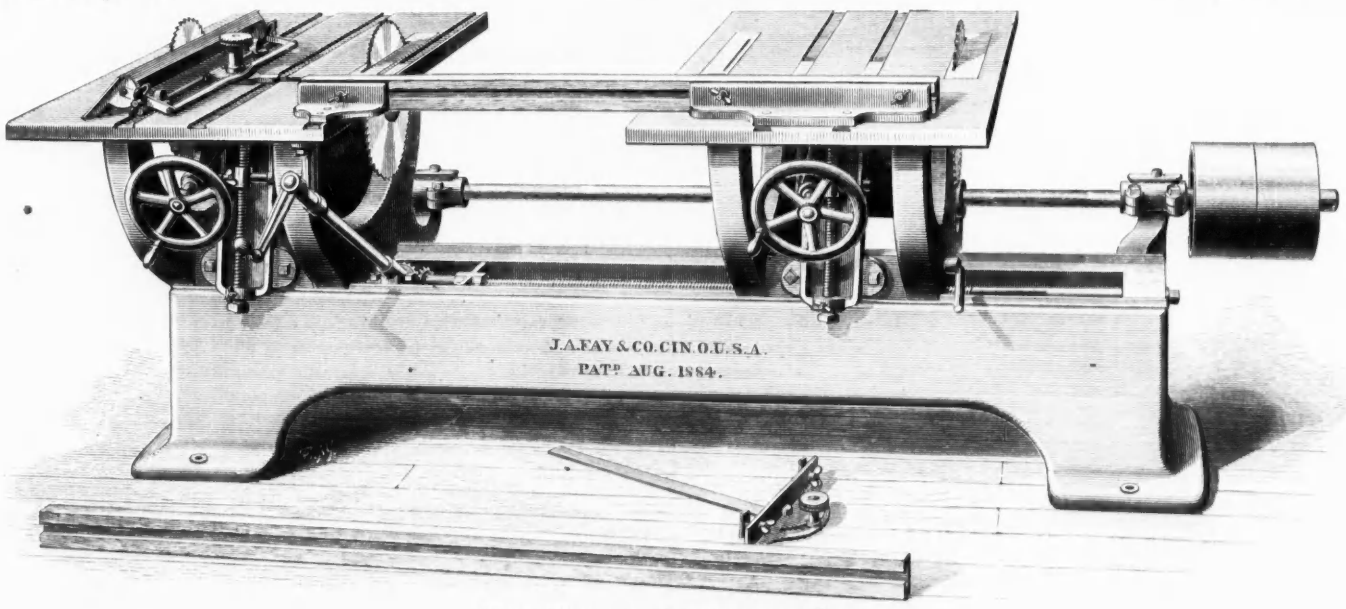
Another cause of sticking in safety valves is found in the guard which is employed to prevent the lever from rising too high and allowing the valve itself to be blown clear from its place. Such guards are quite needful, not merely for the above purpose, but to prevent displacement of the lever in a lateral direction from a blow or from accidental contact of a passer-by. Such a contact might result in serious personal injury. The guard, however, is frequently found tight on the lever, and this should never be the case; at least a quarter-inch play should be permitted, and this should be about evenly divided on both sides of the lever. It is urged that, unless the lever guard is open topped there is danger of a wedge being inserted above the lever to hold down the valve. To this it may be replied that skilled malice cannot be provided for, and the man who would wedge down the lever in a close topped guard, would find means to do the same in the fork guard. All that can be done is to provide for safety against carelessness or ignorance, not against skilled malice, which probably has caused, with its fellow crime, willful foolhardiness, the majority of explosions. The ease with which safety valves of the lever type can be overloaded by a comparatively small additional load is so apparent that the open top valve has now in the best practice been supplanted by valves of the dead-weight type, wherein the weight on the valve is simply the product of the area of the valve by the desired blowing-off pressure. With a 4-inch valve at 100 pounds pressure the necessary weight is thus considerably over half a ton. It is a large mass of metal, and to increase the load on such a valve requires the addition of quite a mass of further material.

Such a mass cannot be placed upon the proper weight without detection, and herein lies a great safeguard against tampering with the valve, which should be and generally is placed on the boiler crown just back of the front head, and therefore fully in sight. The best practice now is to have on each boiler one such dead-weight valve and one combination low water valve which will blow for either too high a pressure or for shortness of water.

Where two or more boilers are set in a battery it is common to see all the closed

valves blowing into one common escape pipe. This is a serious fault on many accounts. In the first place its closure might jeopardize more than one boiler, but a worse defect is that, when a boiler is being cleaned, hot water frequently collects in the escape pipe and falls through the valve upon the boiler cleaner. He very naturally inserts a wooden plug, which he intends to remove, into the safety valve opening, but he may forget, and has, in fact, forgotten to remove such plug. The valve has then been made useless, and unless there is a second valve which is also in working order, an explosion results. Similarly, accidents have been caused or rendered probable by the plugging up of the main steam pipe for the same temporary purpose. An accident has been known to arise from the breakage of a cast-iron safety valve lever. It is almost needless to point out the unsuitable nature of cast-iron for such a purpose. Of late, low-water safety valves have become daily more recommended by reason of the mistrust attaching to fusible plugs, which so often fail to act or only act to a limited extent. Then failure may be due to the formation of a crust of scale on the water side, of a strength and thickness sufficient to withstand the pressure even when the fusible metal has all melted away. We have met with plugs which have leaked slightly and formed a hard scale on the fire side, completely destroying all chance of the plug's action. A year at the outside is usually taken as the term of endurance of a plug. When a year old it is wise to renew the fusible cap, plug or cone, whilst at the same time at every cleaning time of the boiler the fusible plug should be thoroughly cleaned off on the water side, and renewed if it appears to require it. The fire side of the plug must have frequent attention also, to insure prompt action. When too long in use the fusible alloy appears to lose its nature and become vitiated by contact with the water. Against this deterioration it is now customary to employ a thin covering of copper, and it is also best so to arrange the fusible plug that it cannot be blown out in detail. If simply perforated, the outrush of steam promptly prevents further liquefaction of the alloy. To prevent this, means are now employed to retain the whole plug in place until entirely freed by melting, when it is blown bodily out, leaving a full-sized hole for escape of steam into the furnace. Generally the low water valve of good construction is preferable to the plugs, though they both may well be used together. When using low-water valves it is important to note that the float weight will fall when not supported by water. Failure to do so may render the valve inoperative. The danger most to be guarded against in these valves is a wasting of the float, which is usually of some kind of brick, and crumbles under the action of certain waters at times very rapidly.





WOOD-WORKING MACHINERY AT PARIS.

Wood-Working Machinery at Paris.

Continuing our series of illustrations of wood-working machinery exhibited by J. A. Fay & Co., at the Paris Exposition, we present two engravings of sawing machinery of new design. The first of these is a vertical cutting-off saw, with table for straight and angle sawing, and for gaining. It is designed particularly for special kinds of work required in car building. It is built on a heavy column having a broad sole plate, securing large floor support. The face of the column is planed to receive the saw carriage and arbor, which is gibbed to it, and actuated vertically by a screw of coarse pitch, driven by gearing at the bottom. By pressing the foot upon the treadle it can be moved up and down to any point that may be desired. The saw arbor is driven from the countershaft at the base, and so bolted that the tension of the belt is the same at whatever point on the column the carriage may be placed.

The position of the countershaft permits of belting in any direction. The table for the material to rest upon is made independent of the main structure. It is gibbed to the sole plate, and has an adjustment to and from the column by means of a hand-wheel and screw. The top has a radial adjustment for angle sawing and gaining purposes.

The tight and loose pulleys are 12″x4½″, and should make 550 revolutions.

The second illustration is of a double cut-off saw, having a heavy iron frame and elevating arbors, a machine that has proven of great utility for cutting to accurate lengths all kinds of material used in furniture, cabinet, piano, box, sash and door, school furniture, agricultural and other shops. It is a very strong and substantial machine, with heavy iron shears supporting two table frames, one being fixed on the end, and the other made to traverse the shears to and from it by means of an adjusting screw, operated by a removable crank. The operator can very quickly make this adjustment of the table to suit any length of material he may desire to cross cut, both ends being cut off square at one operation. The movable table frame is supplied with a lock attachment for securing it firmly when set to any desired position.

The arbor in each table frame is large in diameter, runs in long bearings, and is made to carry a saw at each end. A prominent feature in these arbors is that they can be elevated, being placed in a substantial swinging frame that is raised and lowered by means of a hand-wheel in front, the belt being retained at its proper tension by means of an idler that adjusts itself to any position in which the arbor may be placed. Motion is communicated to the arbors by means of a countershaft secured to the back of the frame. The driving pulley to the traversing arbor is enclosed by two arms of the table frame, and, as it is moved, slides upon a splined shaft.

The platens are made of iron, with grooves planed in them for receiving the gauges. Wood packing plates are inserted around the saws, which can be taken out for grooving purposes. The tables can be brought together so that material 8″ in length can be cut on both ends perfectly square, or they can be separated so as to cut off material up to 6′ 6″ long.

The machine is furnished with a sliding cross-cut gauge, quickly adjustable for different widths, which is provided with stops to regulate the distance desired to cut, and can be instantly removed or replaced. The stationary table frame is provided with a ripping gauge, which can be beveled to varying angles, or reversed for sawing upon the opposite side of the table. An important feature of this machine is that no sliding carriages are necessary, as the arrangement of the gauges that accompany the machine is such that one operator can work with the grooving saw, and another man cut both ends of the material at once, any length from 22″ to 5′. The countershaft has tight and loose pulleys 10″x5″, and should make 700 revolutions.

The Modern Steam Plant and its Management.

BY PETER H. BULLOCK.

HORSE-POWER RATING OF ENGINES.

Perhaps there is nothing that so much confuses the young engineer as the usual commercial horse-power rating of engines. It is not unusual to find the engines of one maker rated far in excess of those of another, although the sizes may be the same, or even the highest rated the smallest. To explain the reasons why this is so will be the object of this paper, and I hope to make it clear to the youngest engineer reader of the AMERICAN MACHINIST.

All are, or should be, familiar with the general rules for finding the horse-power of an engine, but *figures* will deceive if "facts" are wrong. Perhaps I cannot better illustrate this than by telling how I first got some facts (?) myself.

Some twenty-five years ago, another locomotive fireman and myself essayed to figure up the horse-power of the glittering brass-bound beauty, into the hungry fire-box of which it was a part of my duty to throw daily about four or five cords of wood.

As a preliminary, we ascertained from one of the shop men that we could figure up the horse-power of a locomotive the same as any engine, only to double the result for the two cylinders, and from my engineer, that the "mean effective pressure on the 'General Washington' was 130 pounds to the inch, and don't you let it get much lower, either, Pete." With this information as a starter, we began, according to the formula, by multiplying the area of the 16″ cylinders by the mean effective pressure as given me by the excellent runner whose skill and whiskers I was trying to emulate. Reasoning that the power of an engine must be all that it ever could or did do, the best speed ever made was taken as a basis for our calculations, and a mile in about one minute was our unit for computing the piston speed, working back from the circumference of the drivers to the number of times they must have turned to go a mile, and from this the number of feet per

minute the piston would have to travel in order to keep up with the procession. This ponderous row of figures was divided by the regulation 33,000 pounds, and the result multiplied by two for the other cylinder, as directed by the shop man. The tremendous power of this 16x22 engine, according to our demonstrations, was a surprise to us, and the figures were again gone over; but as no defect could be found, we determined to exhibit our proficiency to the worthy M. M. That official was at once interested. He called our attention to the fact that, by the rules of the road, the speed was limited to 30 miles per hour, and that our time-card did not provide for anything faster. Now, we were aware of the time-card limit, but were also fully persuaded that we had at divers times been over marked miles in one minute. But we also saw that, to insist, might lead to unpleasant inquiries, so we accepted, with mental reservations, the fifty per cent. reduction in the power of the "G. W." Another set of figures was got up on the 30-mile basis and again submitted. This time he showed us that we should subtract the area of the piston rod from one end of the cylinder. Some more power gone. Next time he admitted that the figures were right, but asked me if my engineer always worked the General "in the corner." I replied that he never did that; but, on the contrary, he kept well hooked up at all times when possible.

When we came out from his office, a half hour later, I was dizzy from the information I had absorbed in that time. On a piece of brown paper he had drawn a cylinder and valve motion. He had shown us the effect of wire drawing the steam at the throttle, and the expansion when cutting off by hooking up the links, and how the mean effective pressure was the average pressure on the piston during the whole of the stroke, and how it was controlled by the levers. In fact, he seemed to lead us to an open door, within which we could see things, the existence of which we had never dreamed of before. By the new light we there received, the "General Washington" dwindled into an engine of quite moderate power.

A friend was looking for a 25 horse-power portable boiler and engine, and found one so rated by the builders, who were willing to warrant it to develop that power under test. He noted the size of the cylinder, and the pressure the boiler was to carry, and purchased of another party one of the same size, being assured that the boiler was large enough for the engine, and that they would warrant it to stand the same pressure as the one he had been looking at, which was all true enough. When he got the engine into position and his work on, he found it was not capable of doing it properly, and that it developed but about 16 horse-power. The writer was appealed to for an explanation, which was made in about the following words:

"The engine you did not buy has a piston valve and a variable cut-off, controlled by a fly-wheel governor, and has a range of from 0 to ¾ stroke at nearly full boiler pressure. It runs at 250 revolutions per minute, and it is quite possible for it to exert a force equal to raising one ton one foot high 500 times in one minute, as the cylinder is filled twice in each revolution. The engine you did buy has a plain slide valve and a throttling governor, which probably reduces the pressure one half between the boiler and steam chest. With your engine anywhere near speed it probably cannot exert a force equal to lifting over 1,400 pounds one foot high 400 times in one minute. You see that the engine you got is not of the same power, although it has as large a cylinder as the one you did not buy. You say the firm told you that the boiler was ample for the engine; so it is, but it would not be large enough for the *other engine*. You have simply been deceived by assuming that the two engines were of the same power because they were alike in size and the pressure *in the boilers* equal. Pressure in a boiler is not a measure of power at work. You did not take into consideration the mean effective or average pressure in the cylinder, and the means of getting it there, nor the *number* of times this force was to be exerted in a given time—two very vital things to know."

The above illustrates how important it is that all the facts and all their bearings one to another should be known. It is not to be expected that every purchaser of a steam engine can know all these things, and the absence of such knowledge is the very good reason why they should consult those who do know, and pay for such service the same as they do for legal or medical advice.

Of course, the indicator is now almost universally used to make visible the facts regarding the distribution of steam in engines; but if the actual facts are known, very correct results can be obtained by using the well-known laws regarding the expansion of gases, and computing the pressure at different points of the stroke from them. Indeed, the things we learn from the use of the indicator, regarding the admission and release of the steam, and the amount and character of the counter pressure, and the phenomena of evaporation, are of more actual value than what it shows regarding the expansion of the steam after it is admitted; for, as said before, the latter can be computed, while the facts regarding the former can only be conjectured, unless determined by an accurate diagram.

In one of the earlier papers of this series, the writer referred to a steam plant about

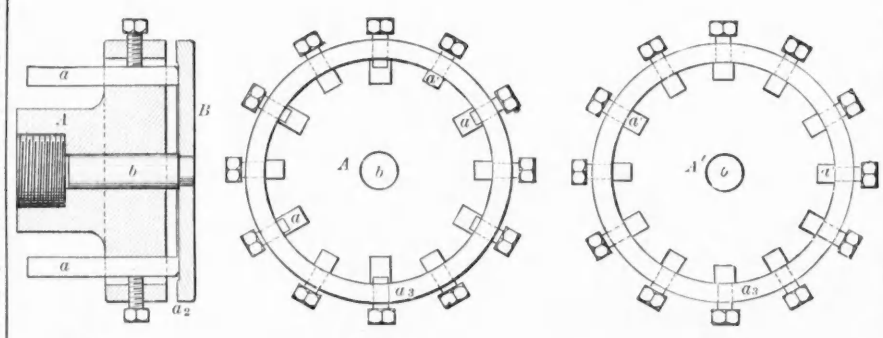


Fig. 1 *Fig. 2* *Fig. 3*

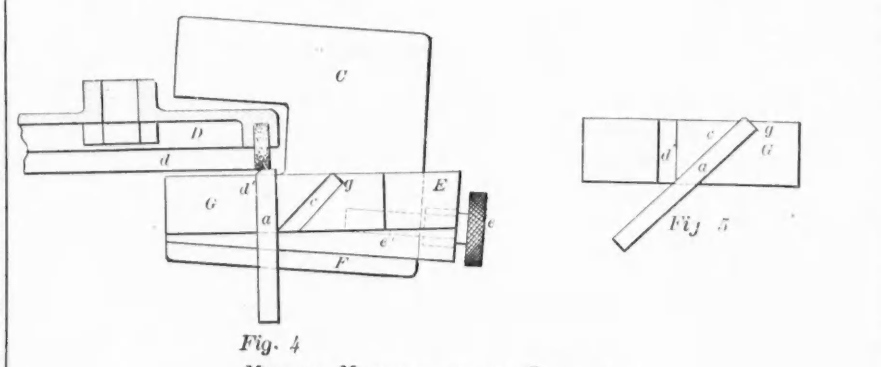


Fig. 4

MILLING MACHINE AND ITS OPERATIONS.

which the owner gave some very remarkable figures concerning the amount of coal burned per foot of grate surface per hour, and the horse-power he claimed to develop. Had all his figures been founded on facts, it would, indeed, have been a wonderful plant; for the consumption of coal would have been less than one pound per horse-power per hour—a result not yet obtained by engines and boilers built with especial reference to economy, much less by any engine having slide valve and throttling governor, as this one had.

Spending a few days in the vicinity of this mill, the writer was induced, principally by curiosity, to ascertain a few facts regarding this engine, for which the owner claimed so much. There was no indicator to be had, nor had there ever been one attached; but there were two tanks of water at different levels in the establishment, and, as the pressure of a column of water at any given height is known, it was easy to compare a gauge with these known pressures, and adjust the reading of it to them. With this gauge attached to the steam chest, and noting the average pressure there when running, it was possible to know what the initial pressure of steam on the piston was. The point of cut-off and release was found by removing the chest cover, and noting the points as the engine was turned by hand. A diagram was then constructed from these facts, and, while the results were very good for that kind of an engine, the figures showed an enormous increase in fuel per horse-power, and as big a reduction in actual power from what they had supposed they were producing.

The foregoing simply shows the necessity of knowing all the facts relating to the subject in order to form a correct estimate of what an engine is or may be capable of doing; for the same engine might develop double the power for which it was designed, if the conditions of pressure and speed were practical; or, in other words, it would only be necessary for the engine to lift either double the number of pounds each stroke by increasing the pressure, or else the same number of pounds twice as many times in a minute by doubling the speed. It is simply a matter of weight, height and time, and in an engine it is represented by the average pressure on a given area of piston through a certain number of feet in a given time. This gives the number of foot-pounds—the accepted unit of power.

The Milling Machine and its Operations.

BY A. B. LANDIS.

The drawing herewith illustrates a cutter head for face milling, with either horizontal or vertical arbor. This head, although an old device, may be new to many.

The principle features I wish to show here are that of the plan of bringing the cutters perfectly true on their edge, with a rapidity not attainable by the old method of gauging each one separately. The head *A* can be screwed or otherwise fastened onto the milling machine arbor. A perfectly true and reamed hole *b* is bored in this head to receive the stem of plate *B*, made a neat fit in the hole *b*, said stem being turned and ground perfectly true with the face a^2 of plate *B*. This plate can be turned plain on the face in case of head A^1, Fig. 3, where all the cutters are the same distance from the center, the purpose of the plate is to allow all the cutters to rest against it when loose, and in that position to draw up the screws, thus leaving a true face on the ends of the cutters. In the case of the head, as in Fig. 2, where every alternate cutter *a* is set closer to the center to form a finishing cutter, while the cutter a^1, being out farther, is the roughing cutter, the plate *B* has its face turned as shown in section in Fig. 1, with the inner surface, by which the finishing cutter is set, turned as much lower as is required for the finishing cut, then the cutters can be rapidly and accurately set, and, when secured by the screws, the plate *B* can be withdrawn from the head, and it is ready for operation. This will produce excellent work, provided, however, the cutters have been properly ground, which rarely ever is the case when ground by hand on a grindstone. Fig. 4 illustrates my method of doing this work. I use an emery ring *d*, inserted into a grooved plate *D*, which I secure by heating the plate so that it will melt shellac, and with a quantity in the groove pressing the ring into it. This plate *D* is mounted on a tool grinding arbor. A plate *C*, is held on the ordinary tool rest whose surface is a right angle to the plane of the plate. This plate *C* has a shoulder *F* on the one edge, against which a block *E* rests, and is held down by any suitable means, so as to allow of a longitudinal motion, and operated by the screw *e*, which is screwed into the plate *C*. This plate *e* has a shoulder e^1 at an angle of about 10 or 15 degrees to the edge sliding against the shoulder *F* of the plate *C*. A block *G*, having a right-angled groove d^1, the bottom of which is inclined sufficient to grind the proper clearance on the end of the cutters *a*. The cutter fits this groove sidewise, and by placing the cutter therein and holding it with the thumb or a small clamp, and sliding the block *G* back and forth, the end of the cutter is ground by the ring *d*. As more is required to be ground, it is slowly adjusted to the wheel by the screw *e*. This grinds the ends of all the cutters at right angles to the side, and, when secured in the slots, they make smooth milling work. In order to make all the cutters cut equally, it is important to have the angles of the cutters ground equally, which, if done by hand, is rarely ever the case. To get correct results in this particular, I cut a slot *C* in the block *G* at whatever angle it is desired to have it (I use 45°). The bottom of this slot also slopes to give correct clearance. A shoulder *g* is formed in the slot *c*, against which the already ground end of the cutter is held, and then, by sliding the block *G* back and forth, all of the cutter being finally finished at one setting of the block *E*, they are all ground uniformly; hence, in use, one cutter does the same amount of cutting as another. This method gives excellent results, and is worth many times more than it costs to rig up for.

My method (which no doubt is the same as others) of making this head, is to turn up the body and mill the slots, and then shrink a ring a^3 over it, and drill and tap for the screws. This ring, to give good service, should be made of steel, and this makes a very serviceable and durable head.

LETTERS FROM PRACTICAL MEN.

Wear of Cylinders.

Editor American Machinist:

I notice in No. 28, Question 277, that the question is asked why locomotive cylinders wear the largest at the ends.

All cylinders using steam expansively with steam packing on the piston wear the cylinders largest at the ends, for the reason that the pressure on the packing was greatest at the ends, causing greater friction at those points.

I had a 28″ cylinder that had steam packing that in four years had worn the ends ⅛″ larger than the center of the cylinder.

W. E. CRANE.

Unspiked Rails and Wrecks.

Editor American Machinist:

Anent your article, "A Needless Wreck," I would like to say that track repairing has been going on from New Haven to Meriden for several weeks, and one day, while soliciting trade in the last named city, I had occasion to walk down the track. Just at that moment an express came flying along, and after it passed I was startled to see that the new track was held down with an occasional spike only. I called the boss workman's attention to the carelessness, and he answered offhand that "there was no danger," that "the train always followed the track with less spikes to hold the rail down." The fact is that they would draw the spikes from ten or fifteen rails, and with a crowbar force them aside into the space between the north and south tracks, thus leaving the fish plate unbolted. Of course work would be immediately commenced on the new section to replace that placed aside. But if it happened there was plenty of time before the next train, the full complement of spikes would

be driven, if not, *"a few would hold until the train passed!"* I knew that an accident must happen with such gross carelessness, and so it has proved. H. F. FRASSE.

Indicator Rig.

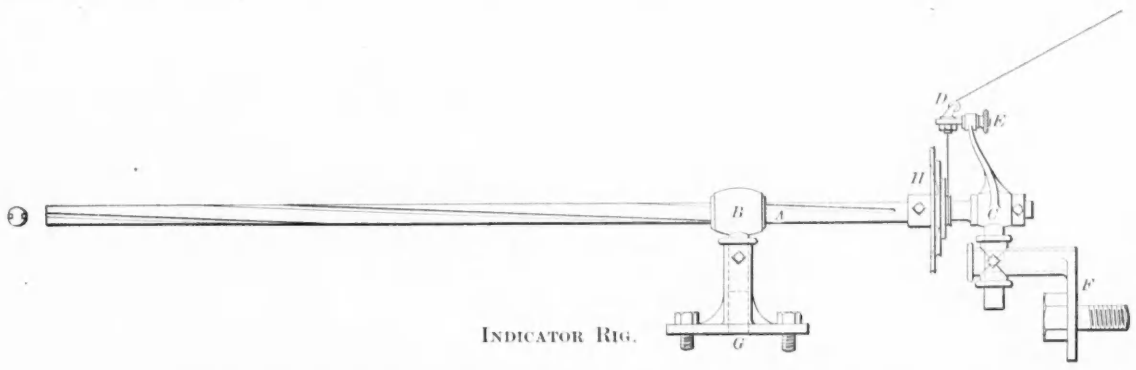
Editor American Machinist:

I enclose you sketch of a universal indicator rig devised to take the place of the cumbrous and generally inaccurate vibrating lever and arc in common use.

The device consists of a spirally grooved rod *A*, nicely fitted and free to revolve in the bearing *C* which is fastened to the cylinder head or engine frame at *F*.

The babbited nut *B* is fastened to the crosshead at *G*, and moves freely, but without "lost motion," in the accurately milled grooves of the rod *A*.

Should the stroke of the engine be equal to the full length of the spiral rod, the latter will make one revolution on its axis, and the smallest drum of the cone will give sufficient motion to the indicator; but if the stroke is less, a correspondingly larger drum will be required, in which case the cone will need to be moved lengthwise on the bar, to bring the indicator cord in correct line with the sheave *D*. At the same time sheave *D* will be given a slight inclination, by means of nut *E*, towards the larger diameter of the cone.



INDICATOR RIG.

The indicator cord may be led in any direction from the sheave *D*.

In rigs for high-speed engines the inertia of moving parts is quite an item, so much so that it precludes the use of the ordinary reducing wheels and seriously affects nearly all devices.

In the rig shown in sketch this trouble is avoided to a considerable extent, by making the moving parts small in diameter and having them rotate on their own axes, consequently causing them to travel through small amount of space, thus reducing the inertia to a minimum. Instead of the cone pulley *H*, as shown, it may be better, in order to reduce weight while using, to have separate drums of various sizes, placing on the rig only the one required.

The adjustments shown in sketch are for convenience in fastening to various styles of engines, and will be readily understood.

FRANK A. RIDER.

Practical Details of Blacksmithing.

BY B. F. SPALDING.

BAD METHODS OF HEATING—CONTINUOUS HEATING—CAPACITY OF BOLT HEADERS—WATER FRONT FURNACES—CLEANING THEM OUT—THEIR GREAT EFFICIENCY.

As blacksmithing is the art of shaping iron and steel while softened by the action of heat, it includes, of course, the art of generating and applying heat for the purpose of producing this softening.

Among other particulars, the expense of forged work is made up partly of the time required to perform the labor of shaping the work, partly of the cost of fuel used for heating it, and partly of the time spent in waiting for it to heat. These are but a few of the principal items among a number which enter into the sum total, the reduction in cost of any of which decreases it. The heating is one of the most important.

The blacksmith who carries on business for himself, and purchases his own coal, takes very good care to make it go as far as possible, and so, while he has one piece in his fire's hottest center, bringing it up to the heat he intends to work it at, he has other pieces laid on the coals, getting warmed up by the heat which would otherwise go to waste. Some, who have learned the trade of general blacksmithing in custom shops, have acquired this, which, in such shops, is a meritorious habit, and unfortunately they adhere to it, still thinking it is good, notwithstanding the altered circumstances, after they have worked their way into machine shops, and have come to serve in the capacity of tool makers and tool dressers. The manifested disposition to economize wins the approbation of their employers, and they go on year after year, submitting the good steel which is brought to them to work, to all the deleterious gases that arise from the combustion of bituminous coal, with complacent self-gratulation and the approval of their employers. The imagination of the most sublime poet, when put upon the rack to form an idea of the worst place imaginable, conceived of a region filled with the fumes of sublimating brimstone produced by sulphurous combustion. Such a place is as bad for iron and steel as for anything else. It may be beneficial to soak straw bonnets in the acid vapors of burning sulphur, but when iron or steel are to be heated—unless they are placed in a muffle—the quicker they can be brought into a region of incandescent carbon the better it will be for them. A charcoal fire is the best for a tool dresser, but if he must use sea coal let him bestow all his care and skill on one tool at a time.

Forging that is done by hand requires the exercise of so much muscular force that very often the blacksmith needs the time required to heat his iron, to recuperate his exhausted energies to work off the coming heat; but there is a large class of work that is done by machinery, which does not call for any more exhausting toil than is performed by an accountant. It is simply tedious, and, at some seasons of the year, disagreeable on account of the heat. It is more tiresome to stand by a fire that is not heating the work fast enough to give the machine it is intended to supply all that it can do, than it is to attend one which is keeping the heats always ready.

In a great many cases it will be found, when the matter is properly looked into, that the reason why there is twice the amount of work done with a given machine in one shop than in another, is that in that shop the facilities for heating are twice as good. In one the furnace is of sufficient capacity, and in the other the product of the machine is limited by the want of means for heating the iron for it.

In some of the large manufactories of New England, where cotton mill work was made, the first work that the apprentice to the blacksmith's trade was set to do, some years ago, was to heat spindles to be forged at the trip-hammer. The furnaces were so constructed that the anthracite coal, cracked to about nut size, which was used as fuel, was fed in at the sides, below the surface of the fire, and the hoppers were kept full, thus giving but a slight chance for the escape of heat by those outlets. The only way for it to get out was through the opening under the cap, where the spindles were inserted and kept from rolling together by grooved pieces of iron laid on the brick a little back from the mouth, where they were not badly exposed to the heat. The cap being set but a little above the opening, kept the heat well in and down and made it quite even, so that pieces were heated uniformly that were twice as long as the width of the opening. Sometimes the mouth was stopped by an iron piece which filled it, and which was drilled with a row of holes, through which the spindles were placed. This was for continuous heating, and was the forerunner of such furnaces as are now used for such quick and continuous heating as is required at the present time for the bolt headers.

The invention of the bolt-heading machines was a great step of applied science to the art of blacksmithing. Before it was made, the forging of bolts, in some of the shops which had as many as fifty men in the blacksmithing department, was a large part of the work, and kept half of the force employed; but when these machines had been introduced, two of them could do the same amount of work with only four men to attend them. Their product has since been largely increased. It will be noticed that the heating facilities had to be increased in proportion to the increased rate of production to each man; for, while each of the twenty-five men had a fire to heat his three or four hundred half-inch bolts, each of the two machines that took their place had to have twelve times as many heated.

The problem to be solved was to get a furnace with a long, narrow mouth, that would hold a long row of pieces, and not let a great amount of heat escape. It was also advisable to keep the fuel so close to the pieces that they would get all the benefit of its combustion. Heat, like light, dissipates rapidly by diffusion. There has always been a difficulty about making long caps without the use of the arch principle. Flat tiles soon crack, and built-up caps, which were made of ordinary fire-brick, and banded with iron, did not give very good satisfaction. The Bradley furnaces now have excellent contrivances for the purpose. The problem was solved for the bolt-header furnaces, by making water fronts, and sometimes water sides and backs, and feeding the fine fuel, coke or coal, from the top.

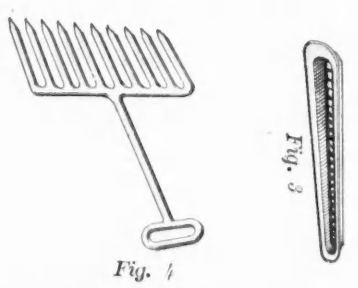


Fig. 1

Fig. 3

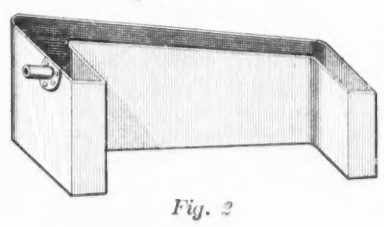


Fig. 2

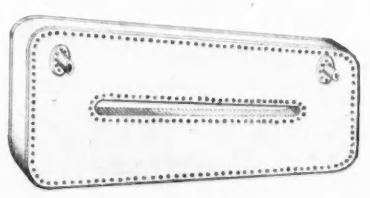


Fig. 4

The water front was made by preparing a frame of about $2\frac{1}{4}''$x$1\frac{1}{4}''$ iron bent around flatwise to the shape of the outline desired, and another of the same sized stock, the inside of which was of the size and shape desired for the mouth. Holes were drilled through these at intervals of half an inch apart, and sheets of iron a quarter of an inch thick were cut out for the sides and drilled to correspond. Sockets for the reception of the feed and outlet pipes were then riveted to the outer sheet, and the sheets were then riveted to the frames, as shown by the illustrations. (See Fig. 1.)

The iron back and sides were cast in one piece, in the form of a box, with three hollow sides. From the front outlet the water ran into the top of this, and the overflow found outlet at a pipe inserted for the purpose. (See Fig. 2.) The front and back were set in place over the table to which the wind-box was attached, and fastened together with straps and bolts. A mouth-piece of cast-iron was provided (see Fig. 3) drilled with holes to correspond with the size of the iron to be heated. These were made light and could be easily changed, even while the fire was burning. This furnace was fed from the top, and the bolts were heated in direct contact with the fuel, as the mouth-piece prevented it from falling out, and the live coals were kept, therefore, above the mouth. The calculation was that there should always be fuel enough on top, becoming heated, so that by the time it had fallen down to the mouth, where the work was to be done, it should be at its highest temperature. As the volatile portion consumed, the ashes and slag fell below this point, to the bottom of the furnace. When they had accumulated so much as to clog the furnace, and keep the hot coals above the mouth, the mouth-piece was taken out, and a broad fire fork (Fig. 4) was shoved into the mouth, through the fuel, to the back. This upheld all the coal above it like a grate. The wind-box grate was then let down, and all that was below the fork cleaned out. Then the wind box was shut again, its grate raised to its proper position, the fire fork was withdrawn and let the clean bed of white, hot coals, which rested upon it, down on the grate, the furnace was replenished with fuel, and, after but a brief detention, was ready for use.

With a furnace of this description the amount of work that could be heated was only limited by the activity of the person in attendance. As fast as he could put the pieces in and take them out, they were hot. "How quick those irons heat; it seems as though they only had time to touch the fire, before they come out burning hot!" said a gentleman, who, for the first time in his life, perhaps, looked at such a thing. The heater was so quick that his motions in letting go of one iron, and taking hold of the next, had not been noticed by the observer, and he thought that the bolt he saw put in had become heated in that brief space of time. When the matter is considered, it is evident that the furnace was just as efficient as though this had really been the case.

James Beggs.

The many friends of Mr. James Beggs, the well-known mechanical engineer, and member of American Society of Mechanical Engineers, will be grieved to hear of his death, which took place by his own hand at Trenton, N. J., Friday, July 19th. No doubt is entertained but that his death was the result of temporary insanity, since his business affairs are known to have been in a prosperous condition, and his domestic affairs entirely harmonious.

The people at his place of business had noticed that he had become unusually nervous and irritable, and a friend, who accompanied him on his journey to Trenton, relates incidents which took place during the trip, which strongly indicate a deranged mental condition.

Mr. Beggs was well known in this city, was highly esteemed among his acquaintances, and was regarded as a remarkably generous and kind-hearted man. He was born in Paterson, N. J., about fifty years ago, and was educated and brought up to the profession by his father, who was a mechanical engineer, and a native of Scotland. The first position of importance which he held was that of Master Mechanic of the Delaware, Lackawanna and Western shops, at Scranton, Pa., and he afterwards held various positions of responsibility, afterwards starting the business of which he was the head at the time of his death, which was that of dealer in machinery supplies, with shops at Erie, Pa. It is estimated that he has left a fortune of at least $100,000.

Mr. Beggs was a Union soldier throughout the war, having served in Kearney's brigade. At the time of his death he was consulting engineer of the Paterson water-works, in which place he resided.

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The Right to an Invention.

We are in receipt of a letter from a machinist who ten years ago was employed by a concern doing a large business in building portable engines. He invented an improvement upon these engines, which he tested and found to work satisfactorily, after which he made a model of it for the patent office. The assistant superintendent of the works took this model to the office of the company, and our friend, supposing that he would be called in and the matter adjusted, did nothing about it until the next thing he knew concerning it, the assistant superintendent had been granted a patent upon it, and had assigned it to the company, though he had nothing whatever to do with inventing it. The company has since placed it upon every engine built by them, numbering thousands.

Our friend was deterred from any very vigorous effort to maintain his rights at the time, for the reason that not only himself, but also the witnesses whom he would have to depend upon were employed by the concern, and would probably lose their places by giving testimony in his favor. This is not now the case, and he wishes to know what he can do.

As this case is typical of many others, it seems to us proper to discuss some of its features here. When a patent has been granted to an individual by the patent office, it will not be recalled and given to another, even though it be proven that it was obtained by fraud. If the applications of two or more persons are in the office at the same time for patents upon the same device, they are said to be in interference, and the office will decide which is the real and prior inventor; but a patent having been issued, nothing can be done except to attack it in the courts, or infringe upon it and defend the suit which may be brought for such infringment. In this case nothing is done except to render the patent worthless. If the suit is decided against the holder of the patent, the right to infringe upon it is thereby established, and, of course, it is rendered worthless to the holder; but no one else can in this way acquire the right to exclusive use of the device, even though he prove conclusively that he was the real or original inventor to whom the patent should have been granted.

Our friend might succeed in a suit for damages, but the advisability of instituting such a suit would be a question for a lawyer to decide after a full examination of all the circumstances, and its final outcome would depend upon the courts, the patent office having nothing to do with it. In such a suit the relative wealth of the contesting parties would, we regret to say, probably have a great influence, and unless the interests involved are very large, it is not wise to go into them.

In this instance the company would probably set up the claim that the invention was made in their establishment by a man in their employ, and upon their time, and therefore rightly belonged to them. But it has been decided by the courts repeatedly that such a claim is not valid, unless the inventor has been employed, and paid for inventing, and with the distinct understanding that any improvements made by him shall be assigned to his employer. This is manifestly just, and, if it were otherwise, the benefits resulting from the majority of really valuable patents would be enjoyed by those who had nothing whatever to do with originating them, and much of the incentive for the most useful inventions would be gone. That the inventor was not in this case employed as an inventor, nor with the understanding that improvements devised by him were to be assigned to his employers, is sufficiently shown by the action of the assistant superintendent in applying for the patent, with himself in the role of inventor, and, of course, making a false affirmation or oath in order to do so, instead of having the real inventor make the application, as he would have done if there had been any understanding that wages were paid as compensation for invention.

Our friend has evidently been robbed as literally as if actual tangible property had been taken from him by force, but we fear there is no practical remedy for him now, though there ought to be.

Most employers, we think, see the importance to themselves, in a business way, of encouraging inventions by their workmen, but, nevertheless, it is far too common for them to discourage it by such methods as are given above, and where workmen find themselves in the employ of such concerns, their only practical protection is to keep the knowledge of their inventions to themselves until they are secured. There is, of course, a moral side to the question also, and there are employers who are too conscientious to take what does not belong to them without compensation to the owner. Let us hope and believe that they receive their reward, and that the other kind suffer the penalty of their wrongdoing. We know that violations of physical laws always bring their penalty, and all experience teaches that violations of moral law do the same.

Rules and Their Enforcement.

We publish in another column a communication from a well-known business man of this city, who happened to observe the methods of the track repairers on the New York, New Haven & Hartford Railroad—methods which he plainly saw were liable to lead to just such an accident as finally did occur. He was so impressed by the risk they were taking that he was impelled to remonstrate against it, and was nonchalantly informed that there was no danger.

We do not doubt that the man who was in charge of these workmen really believed that there was no danger in the course he was pursuing. One who does a dangerous and foolhardy thing continually, day after day, and knows that others are doing the same thing, finally and gradually acquires the belief that there is no danger. It is a fact well known to railroad men that the practice of these trackmen is almost if not quite the universal practice on all roads all over the country. And where there is a railroad official that does not know this, it is a very easy matter for him to find out about it. He needs only to question the trainmen of his own road. Every railroad man knows that the only safe way to do such work is to have the gang protected by flagmen, and to flag every train down to a speed sufficiently slow to make running over insecurely spiked rails unattended with danger to life or limb in case one of them should fail to hold. The rules of most roads require this; but, nevertheless, the actual practice is to let trains run over such places at full speed—no flagging being done.

At first thought it might be supposed that the man in charge of the track-laying gang could be justly held solely responsible for the consequences which, in this instance, resulted from it; but we think that, upon looking further into the matter, it will be seen that others should divide the responsibility with him.

No matter what the printed rules of a railroad company may be, when a man is put in charge of a gang of track-layers he is expected to do the work at the minimum cost, and with the least possible delay to trains. He knows that the record which he is expected to equal, and which it is usually his ambition to excel, was made by breaking the rules of the road relating to the flagging of trains, and that if he holds his place he must also break those rules. We believe that railroad officials are generally aware of these facts, and know that many of the rules calculated to add to the safety of trains are habitually broken. While they do not, of course, openly countenance such violations of rules, in effect they compel their violation by requiring of the men things which cannot be done consistently with them.

It is thus that violations of rules often come to be winked at by those whose special duty it is supposed to be to enforce them, and the only occasion when they are brought prominently forward is when they can act as a screen to protect some one from the consequences resulting from their non-observance. Such an instance was to be seen some time since on a road which, having paid some heavy awards for damages resulting from injuries to brakemen in coupling cars, made a rule that all brakemen were to use a stick for the purpose of lifting and guiding the link into the drawhead when making a coupling. The road never enforced the rule, and apparently its only object was to be referred to in court in case of damage suits, to prove that brakemen were injured only because of their own perverse violation of rules. We concede that it may not be improper, and for the protection of the public may be necessary to let trackmen know that a term in penitentiary may result from such gross carelessness as was displayed in this instance; but at the same time we think that it should be impressed upon the companies that the mere promulgation of rules for the safety of passengers is not sufficient to relieve them of responsibility, but that the *enforcement* of those rules also devolves upon them.

The evidence of bad faith on the part of the Armstrong Company in its dealings with our Navy Department in the matter of the plans for the cruiser "Charleston," seems quite conclusive. After paying to the English firm a large sum for the drawings, with the understanding that from them could be constructed a vessel exactly like the Japanese cruiser "Naniwakan," which had been built by the Armstrongs, and had attained a record of eighteen knots an hour developing 7,500 horse-power, it is discovered that those drawings do not really represent a vessel and machinery capable of such a performance, and that the vessel built from them underwent important changes before attaining her record, changes which were not made upon the drawings, but which should have been made there before the Armstrongs or any one else could properly claim that they were the drawings of the "Naniwakan."

When important changes are made in any construction, and are not noted upon the drawings, the drawings cease to represent the construction, and the sale of them, with the understanding that they do represent it, is a fraud. On account of the changes which the trial of the "Charleston" proved were necessary, the contract time has been extended, and of course considerable extra expense incurred. Upon the whole, we think the best plan for the Navy Department to pursue is to have its drawings made at home. They can be made here, and the need for a powerful navy is not so urgent but that time can be taken to make drawings. And in fact there is considerable indication that the need for a navy does not manifest itself very strongly until after the navy is constructed.

Questions and Answers

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(292) R. P., New York, asks: Is there a practical work published on injectors? *A.*—We do not know of such a work. Probably the nearest approach to it would be found in the catalogues and descriptive matter of the various manufacturers.

(293) "Cogs" ——, writes: Please inform me whether or not it is possible or difficult to make a bevel gear or pinion that will run correctly with several gears of different sizes and numbers of teeth, but of same pitch—all cast gears? *A.*—It is at least difficult to do this, and we do not know of its having been accomplished.

(294) G. R. H., York, Pa., asks: How many cubic feet of space will a ton of ice keep at 32 degrees Fahrenheit per 24 hours? And how many feet of 1-inch pipe will it take to do the same amount of refrigerating, using brine at 10 degrees, and also at 26 degrees Fahrenheit? *A.*—The space to be kept at a given temperature will depend on the kind of building, the ventilation, the kinds of winds to which the building is exposed, and the climate. It seems to us that you can obtain the required information only by a tentative process, guided by considerable experience. We have had no experience in this line, neither have we any data which will enable us to make a calculation. Perhaps some of our readers may furnish us with rules and data which will enable us to work out the problem.

(295) H. B. C., Brooklyn, N. Y., writes: In a certain boiler manufactory they have up to the present time been selling boilers under a guarantee that they shall develop their full rated horse-power, on the basis of an evaporation under atmospheric presssure of 30 pounds of water per hour from feed-water at 212°. The correctness of this rating has recently been questioned. I find that the standard adopted by the centennial committee, namely, 30 pounds of water evaporated per hour at 70 pounds pressure from feed-water at 100°, is equivalent to about 34.5 pounds evaporated under the former conditions. Calculating the amount of air which would be displaced by a cubic foot of water evaporated per hour, I find that it would represent about 1.76 horse-power, or 35.4 pounds of water per horse-power per hour. I believe that the first rule for measuring the horse-power has been used by a considerable number of boiler makers, and would like to know what authority there is for such rating. *A.*—30 pounds of feed-water evaporated from and at 212° per horse-power, is a customary arbitrary standard, and is based upon the assumption, that it will produce a horse-power in average practice. See paper on "Estimates for Steam Users," reported in the Transactions of the American Society of Mechanical Engineers, Vol. 5

(296) O. R., New York, asks: Will the quality of iron castings be affected by the use of scrap-iron or wood which has been painted with lead color paint? Would it be likely to produce bad castings? Please give any information you can on this matter. *A.*—We referred these questions to Mr. L. C. Jewett, who replied as follows: In a test made Dec. 15, 1888, I found that the introduction of 3-10 of one per cent. of lead caused a deterioration of 12 per cent. in the strength of the cast-iron test bars. That the presence of paint will act injuriously to the iron, I have no doubt; as far as the strength is concerned, it will impair it. But I cannot see that it will have much effect in making the castings dirty. Still it might, for I remember an instance at a locomotive works, in which a lot of locomotive drivers were broken up for scrap; they were old and had been painted until the paint was ⅛ of an inch thick. After the iron had been melted and in the ladle, it gave off fumes that smelled of lead; a thin kind of black leady slag formed on the surface and around the edges of the ladle. I do not recollect that there was any trouble as to the soundness of the castings, but it certainly demonstrated that lead was there, and did not burn up, although lead oxidizes at a high heat. I do not think, in fact I know that it does not all volatilize when in melted hot iron, as the test before mentioned clearly shows from the deterioration in the strength of the test bar. This is, however, the only instance I remember of noticing the fumes from melted iron which previously had been painted.

(297) C. W. S., Island Pond, Vt., writes: Will you kindly give me the following information in regard to heating buildings by steam? 1. What pressure of steam should be used? *A.*—From 2 to 5 pounds pressure will be the safest to use for ordinary buildings; in large buildings, factories, etc., a higher pressure is often used. 2. Give formula for determining the amount of radiator surface necessary to heat a room of given dimensions. *A.*—Mr. W. J. Baldwin, in his book on "Steam Heating for Buildings," says: The ordinary rule-of-thumb way of the average pipe fitter, is, to multiply the length by the breadth of the room, and the result by the height, then cut off two figures from the right-hand side, and call the remainder square feet of heating surface, with an addition of from 15 to 30 per cent. for exposed or corner rooms. This is for high-pressure steam, but for low-pressure—2 to 5 pounds—as much as 100 per cent. is sometimes added, according to the size of the room, and the purpose they are intended for. In computing heating surfaces, however, there is more to be considered, as it is evident the amount of surface necessary for a good and well-constructed building will not be enough for a cheap and poorly put up one. The author further says: The windows are the first and most considerable item. Secondly, consider the outside walls, and how they are plastered—whether on hard walls or on lath and furring. Thirdly, the prospect—whether exposed or sheltered. Fourthly, whether the whole house is to be heated, or only part of it; and lastly, what the building is to be used for."

Table of approximate power for transmitting heat, of various building substances compared with each other.

Window glass	1,000
Oak and walnut sheathing on walls	66 to 100
White pine and pitch pine	80 to 100
Lath and plaster, walls good	75 to 100
" " " common	100 to 150
Common brick (rough)	150
" " (hard finish)	200
" " (hollow walls, hard finish)	150
Sheet iron	1,100 to 1,200

In figuring the wall surface, etc., multiply the superficial area of the wall in square feet by the number opposite the substance in the table, and divide by 1,000 (the value of glass); the product is the equivalent of so many square feet of glass in cooling power, and may be added to the window surface and treated in the same way. The following method (which may be used in place of the rule given) has given good results, and is not wholly empirical. The author referred to has used it for many years in preference to any other: Divide the difference in temperature between that at which the room is to be kept; and the coldest outside atmosphere by the difference between the temperature of the steam pipes and that at which the room is to be kept; the quotient will be the square feet or fraction thereof, of plate or pipe surface to each square foot of glass, or its equivalent in wall surface. Thus: Temperature of room 70°; less temperature outside, 0°; difference, 70°. Again: Temperature of steam pipe, 212°; less temperature of room, 70°; difference, 142°. Thus: 70 ÷ 142 = 0.493, or about half a square foot of heating surface to each square foot of glass or its equivalent—a good common rule for ordinary purposes being three-fourths of a square foot of heating surface to each square foot of glass, or its equivalent in wall surface. Even this rule must be modified to suit certain conditions; for instance, the foregoing rules refer only to direct radiation. But heating surfaces are divided into three classes, namely: direct radiation, indirect radiation, and direct-indirect radiation; for the latter two classes the heating surface must be somewhat changed, and for these changes we must refer our correspondent to the book from which we have quoted. 3. Give formula for determining size of boiler when the sum of radiator surface is known. *A.*—One square foot of boiler to every 10 square feet of radiating surface will answer, assuming that the radiating surface is ample. For indirect radiation, etc., a different proportion must be used. See the work to which we have referred.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

20" Upright Drills. J. E. Snyder, Worcester, Mass.
23" Upright Drills. J. E. Snyder, Worcester, Mass.
25" Upright Drills. J. E. Snyder, Worcester, Mass.
28" Upright Drills. J. E. Snyder, Worcester, Mass.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Duplex Gear Cutters. R. M. Clough, Meriden, Ct.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

See S. W. Card & Co.'s (Mansfield, Mass.) Catalogue of Screw Plates for Gunsmiths and Amateurs.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortland st., N. Y.

Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.

Iron Planers from 16" to 36" wide by any length. H. C. Pease & Co., Worcester, Mass.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Portable Key-seating Machines and Stub Ends for small connections, address T. C. Dill Machine Co., 726 Girard ave., Philadelphia, Pa.

"Useful Hints on Steam." By E. E. Roberts—2nd Edition—96 page book—mailed upon receipt of 20 cents. W. Blitz, 107 Liberty st., N. Y.

The best emery wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

Rubber Belting, all sizes, 77½ per cent. from regular list. All kinds of Rubber Goods at low prices. John W. Buckley, 156 South street, New York.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Patent or shop rights for sale, for perforating iron or steel plates for steam boilers, bridge work, iron or steel ship work, marine boiler heads, equal to drilled work and fifteen times quicker. Samples can be seen and circulars obtained from R. E. Dietz, 60 Laight st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including May 23, 1889 issue, 77 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 92 articles have thus far appeared up to and including the May 30, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

Water-works will be erected at Troy, Ala.

Lincolnton, N. C., will put in water-works soon.

A 20,000 spindle cotton mill will be built at Bessemer, Ala.

A saw mill will be built at Sheffield, Ala., by W. O. Coleman.

A cotton compress, to cost $50,000, is to be built at Taylor, Texas.

Water-works will probably be erected soon at Weatherford, Texas.

Watkins Bros. are building at Mount Ida, Ark., a flour mill and cotton gin.

A planing mill will be erected at Tallahassee, Fla., by the Leon Lumber Co.

A band saw mill will be erected at McMinnville, Tenn., by Mead & Deford.

Planing and grist mills are being erected at Punta Gorda, Va., by T. K. Martin.

The wagon and spoke factory of L. W. Johnson, at Lake City, Fla., is being enlarged.

The Merced Woolen Mills, at Merced, Cal., are to be enlarged, and new machinery added.

A machine shop 40x55 feet is being erected at New Cumberland, W. Va., by Shetter & Co.

At Greensboro, N. C., the Eagle Foundry and Machine shops will erect new and larger buildings.

Edward Powell is building a knitting mill at Newtown, Pa., and will employ in it seventy-five hands.

Mr. G. B. Noble is secretary and treasurer of the newly organized Bridgeport (Conn.) Knitting Co.

A planing mill and wood-working factory is being established at Buena Vista, Va., by Seary & Miller.

A company has been organized at Athens, Ga., by Thomas Bailey, to build a foundry and machine shop.

A flour mill of 40 barrels capacity will probably be erected at Camden, Ky., by Cunningham & Kitzmiller.

The machine shops of the Georgia, Carolina & Northern Railroad Co. will probably be located at Athens, Ga.

The Whitney Gun Co. will soon begin work on a brick factory at Florence, Mass. It will be 40x100, three stories high.

A new paper mill, built by James P. Davis, at Beaver Falls, N. Y., is nearly completed, and ready for the machinery.

The Pilot Mound Milling Co. has been organized at Pilot Mound, Minn., with a capital of $16,000. The company will erect a new flour mill.

The Standard Steel Casting Co. are putting up a spacious brick building adjoining their works at Thurlow, Pa., to be used as a pattern shop.

At Syracuse, N. Y., the Hotchkiss Carriage Co. has been organized, with a capital stock of $25,000, to manufacture carriages, sleighs and vehicles.

The Oakdale Mfg. Co., of Jamestown, N. C., are building a new cotton mill to increase their capacity about one-third. Electric lights will be put in.

A new mill will be built at Sault Ste. Marie, Mich., by the Soo Paper Co. It will have a daily capacity of twelve tons of ground pulp and twelve tons of paper.

Mr. A. B. Laurence, who was formerly with the Underwood Mfg. Co., has become manager of the Shultz Belting Co., 225 Pearl st., and 1a Platt st., New York City.

The Riverside (N. J.) Hosiery Mills, which were destroyed by fire last winter, will be rebuilt by Mr. Dick, late of the firm of Birkhead & Dick, proprietors of the mill.

The Linden Steel Works, of Pittsburgh, Pa., have been awarded the contract for furnishing 428 tons of steel plates for the cruiser "Maine," which is being built at the Brooklyn Navy Yard.

J. E. Lonergan & Co., 211 Race street, Philadelphia, brass manufacturers, are expecting to get their new factory building finished by August 1. The foundry will be located on the top floor.

A cotton mill with a capacity of 5,000 to 10,000 spindles will be erected at Jonesboro, Ga., by a company which has been organized by G. D. Stewart and others. The capital stock is $100,000.

An addition—60x160 feet—is being built to the Demorest Foundry, at Williamsport, Pa. This makes a moulding room 60x320 feet, built in the form of a square. A new cupola will be put in to melt ten tons per day.

The Laidlaw & Dunn Co., of Cincinnati, O., have sold two of their one million gallon "Standard Duplex" steam pumps to the Georgetown (Ky.) water-works. They are now filling orders for six of this capacity.

A $20,000 addition to the plant of the Ypsilanti Paper Company, at Ypsilanti, Mich., is under consideration by this company, the purpose being to manufacture sulphite fiber under a process invented by a member of the company.

Work has been commenced on the new mill of Belding Brothers & Co., at Belding, Mich. It will be of brick, three stories high, 45x200 feet. The engine house will be two stories high, 40x60 feet. Machine twist and sewing silk will be manufactured.

According to a dispatch to one of the Pittsburgh dailies, the Fannie furnace, at Middlesex, recently produced 114 tons of No. 1 foundry iron in twenty-four hours, breaking the world's record for that size furnace. Her best previous record was 100 tons for the same period.

We have received a catalogue from W. H. Kühl, Jäger strasse, Berlin, dealer in general marine literature and books relating to ship building and engineering. The catalogue represents a very large collection of books and literature, and is about as complete a one as we have seen; it not only includes works written in the German language, but also those which have appeared in several other languages, treating on theoretical and practical shipbuilding, engines, boilers, marine architecture, historical and scientific works relating to engineering in general of old and recent date.

The Triumph Compound Engine Co., Cincinnati, Ohio, is fitting up a shop for the manufacture of their new compound engine, and in its equipment is paying much attention to the advantages to be gained through the use of "Special" tools. The Universal Radial Drill Co., of their city, is building them a three-spindle drill to bore their cylinder castings. The G. A. Gray Co., of the same place, is making them a 42" planer, fitted with three heads, and The Richmond City Mill Works are building them a Schellenback pulley lathe, especially adapted to their work. Besides these special tools, they have placed their order for many regular ones.

E. E. Roberts, 107 Liberty street, New York city, has issued the second edition of his *Useful Hints on Steam*, the first edition having met with such a demand from practical steam users and others interested, as to entirely exhaust it. The book contains seventy odd pages of information regarding the nature, properties and use of steam; the principles involved in steam engine and boiler construction and management, which cannot fail to be of use to practical men and to owners of steam plants who are desirous of knowing something of such matters. It is intended for gratuitous distribution, and will be sent to those interested upon application.

The *Manufacturers' Record*, of Baltimore, with a view to making known to the world the vast wealth of the unexplored mineral and timber regions of the South, has organized a fully equipped exploring party, under the management of Major Goldsmith Bernard West, of Birmingham, a noted expert in the exploration of mineral regions. In making this announcement in its last issue, the *Manufacturers' Record* says: "We have arranged to place at once in the field an expedition, scientific and practical, whose duty it shall be to visit, investigate and report upon all the mineral districts of the Southern States." The expense of this exploring expedition will be borne solely by that journal.

The Norton Fluid Metal Rolling Co., 46 River st., Chicago, has been organized to own and operate patents taken out by Edwin Norton, covering a novel process for rolling sheet metals in the fluid state. The mechanism consists essentially of two hollow rolls, mounted on a framework, and having interior water connections, the rolls being geared to revolve at an equal or greater speed than that of the wide, flat stream of molten metal, which is continuously poured between them from a secondary reservoir connected with a cupola, and placed directly above the rolls. The molten metal, not being allowed to dam up, is compressed and set by momentary contact at the meeting line of the rolls. The rolls revolve at a speed of about 400 feet per minute, and the solid sheet, planished on both sides, is produced at the same rate of speed. Auxiliary patents have since been taken out, adapting the process to the production of rails and shapes.

The small tool department of The Pratt & Whitney Co.'s Works, at Hartford, Conn., has grown to such magnitude as to demand a separate catalogue and price list, and one has accordingly been issued, which is devoted exclusively to giving information regarding all small tools made by the company. Among these are taps and dies of all descriptions, patented lathe and planer tools, ratchet drills, straight-edges, dividers, caliper gauges, milling cutters, counter bores, hollow mills, hand punching machines, spiral punches, standard screw gauges, etc. The company inform us that this catalogue includes all the tools formerly made by the Hartford Tool Co., and that the line of milling cutters has been largely extended. The list prices for die stocks, hand and machine taps, machine screw taps, pipe taps, reamers, center reamers, ratchet drills and gauges have been reduced. All pipe taps are now made to Briggs' standard. The catalogue is without an index—a feature which would add much to its convenience.

Machinists' Supplies and Iron.

NEW YORK, July 20th, 1889.

Iron—American Pig.—The market has ruled quiet, though prices are steadily maintained, most of the output of the furnaces being absorbed by contract deliveries. Furnace men are disposed to demand higher prices for future deliveries, especially for foundry grades. We quote, Standard Northern brands, No. 1 X Foundry, $17 to $18; No. 2, $16 to $16.50. Southern brands, No. 1, $16.50 to $17; No. 2, $15.50 to $16; Grey Forge, $14.50 to $15.25.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—By first-class machinist, situation as foreman of general machine shop. J. A., AM. MACH.

Wanted—A position as mech. draftsman; good prac. exp.; marine or stationary. W., AM. MACH.

A young mech. draftsman is now open for engagement. Address BOX 4, AMERICAN MACHINIST.

Foreman pattern maker would like a situation; best of reference. Pattern, BOX 3, AM. MACHINIST.

Tool Keeper—Wanted, a young man of experience to take charge of and give out special tools in a large factory. Topsey Turvey, AM. MACHINIST.

Foreman moulder would like a situation; is accustomed to the handling of men on piece-work. Address Moulder, BOX 2, AMERICAN MACHINIST.

Wanted—A first-class sheet-brass worker; one accustomed to stamping and spinning lamp work; good pay to right man. Metal Worker, AM. MACH.

Wanted, Machinist—A good bench hand for work about like sewing machine adjusting; good wages to right man. Address, with ref., stating age, and wages wanted, Metric Metal Co., Beaver Falls, Pa.

Wanted, Draftsman—Young man, willing to advance, and who has had experience in a machine shop doing a general line of business; state age, wages expected, with full particulars. Address W. T. S., care Letter Carrier No. 7, Louisville, Ky.

Wanted—Foreman for machine shop in Northern Ohio, building engines and saw mills; must be first-class mechanic and disciplinarian, of systematic methods and push; state age, experience, and salary expected. Address W. M., care AM. MACHINIST.

Wanted—A thoroughly competent and 1st class machinist as foreman in engine, mill, and general mach. shops. None but a strictly first-class man, who is a pusher, and has had experience in such capacity, need apply. Address "Machinist" Joliet, Ill.

Wanted—By marine engineer, holding first-class certificate (English) to take charge of machinery ashore or afloat; late chief engineer of steamship 2,000 tons burden; an American, and a practical engineer; age, 28. Address Marine Engineer, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hand Bolt Cutters. S. M. York, Clevld., O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, O.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Send for catalogue of Model Engines, Castings, Electric Bells, etc., Lowell Model Co., 170 Merrimack st., Lowell, Mass.

Wanted—A planing machine, 48"x10 ft.; must be in good order and a bargain. Address Box 114, AMERICAN MACHINIST.

Designs and working drawings for special machinery, tools, etc. attended to by experienced draftsman. "Draftsman," Box 107, AM. MACHINIST.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

For Sale—A well-equipped shop and foundry in Ohio, doing a good business; satisfactory reasons for selling; price, $25,000; terms easy. Address High Speed Engine, care AMERICAN MACHINIST.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—To sell patent or have manufactured on royalty, lathe chuck illustrated in AM. MACHINIST, Sept. 22d, '88. This is a thoroughly practical tool, and in demand, and well worth investigation. Address Chuck, care AMERICAN MACHINIST.

For Sale—A machine shop, with capacity of 30 men, situated on a never-failing water-power in a large manufacturing center, with good jobbing trade and line of specialties, with first-class patterns; is now doing a good business, and will give satisfactory reasons for selling; will sell entire plant or sell machinery and tools and lease the building and power. BOX 1, AMERICAN MACHINIST.

WANTED: Machinery to build. Specialties in CAST IRON to manufacture. Fine, solid CASTINGS for Dies, Moulds, Dynamos, Motors, &c. MANUFACTURER, P. O. Box 886, New Haven, Conn.

Established 1852.

BRADLEY'S HELVE HAMMER.

BRADLEY'S POWER HAMMERS

The BEST in the WORLD

RUN BY BELT.

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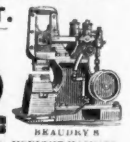

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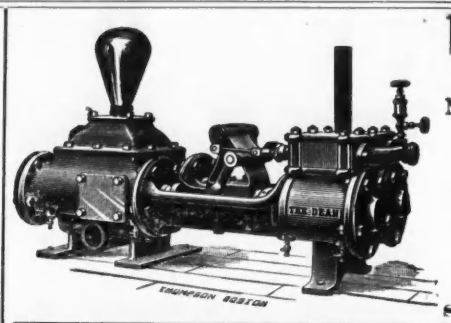

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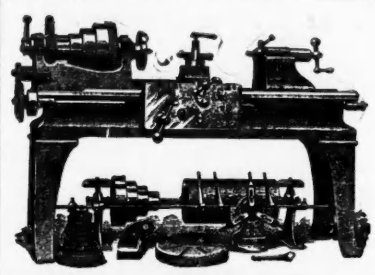

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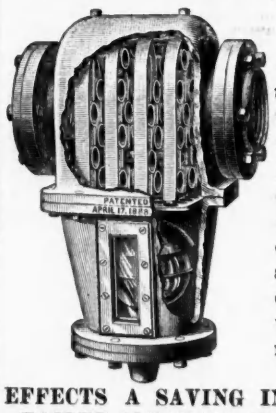

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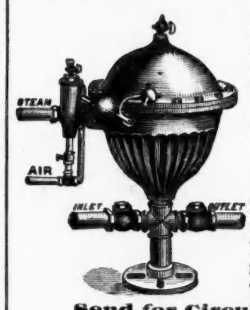

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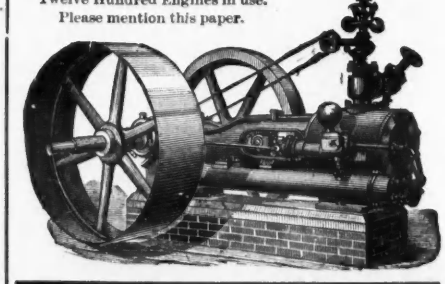

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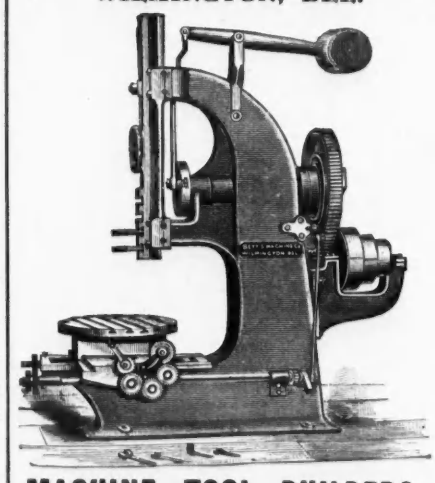

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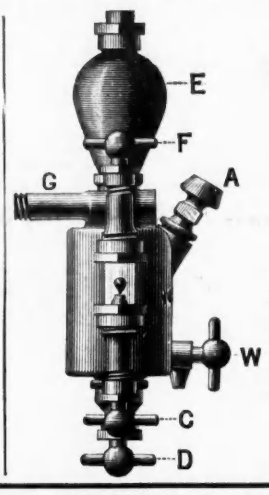

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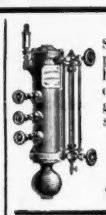

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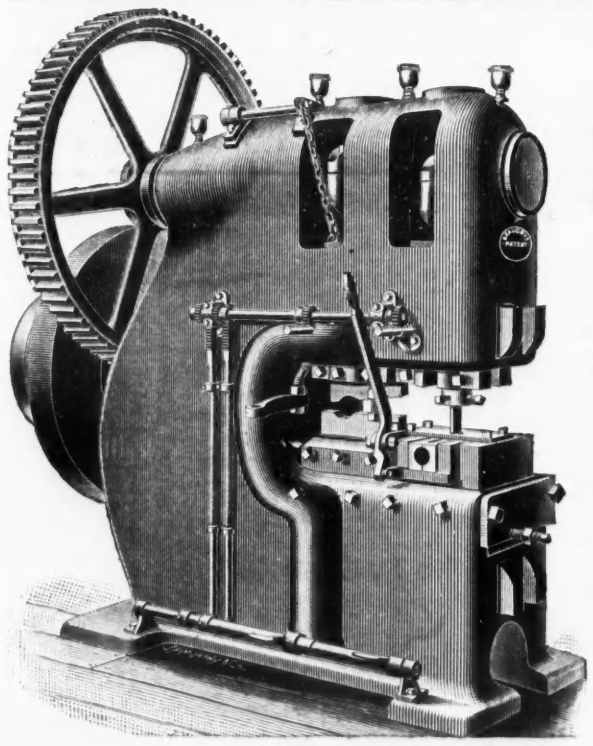

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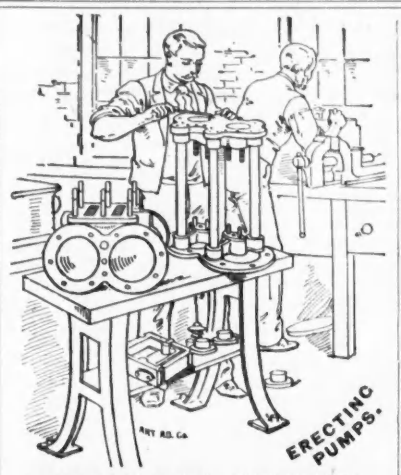

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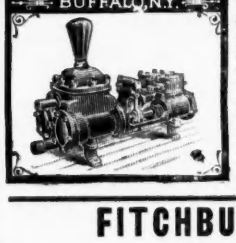

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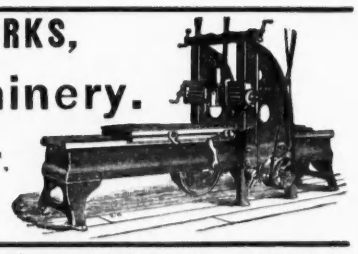

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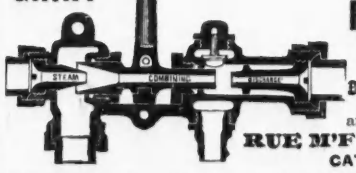

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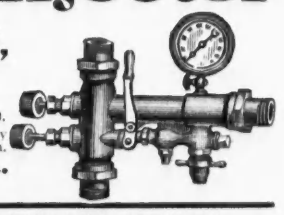

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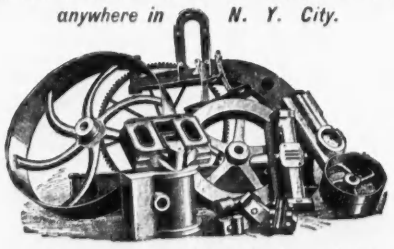

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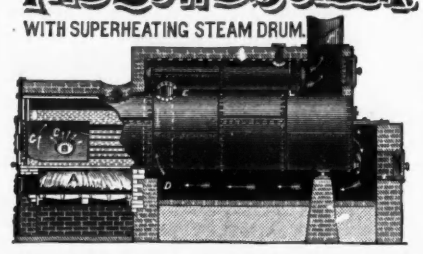

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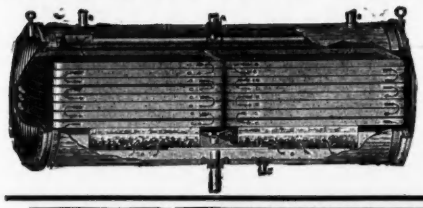

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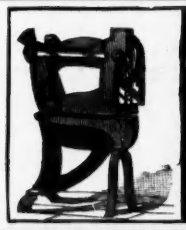

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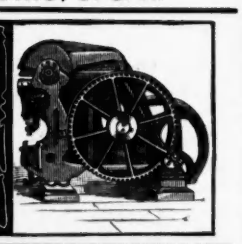

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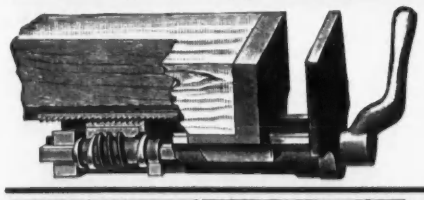

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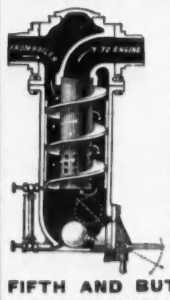

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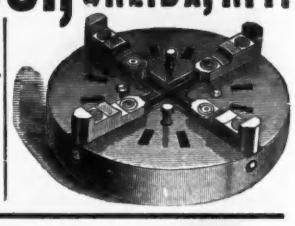

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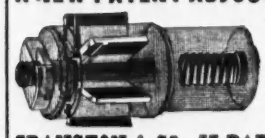

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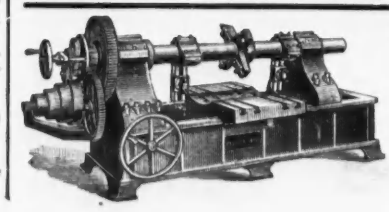

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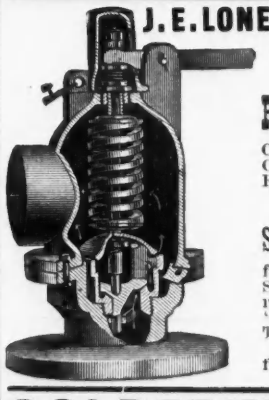

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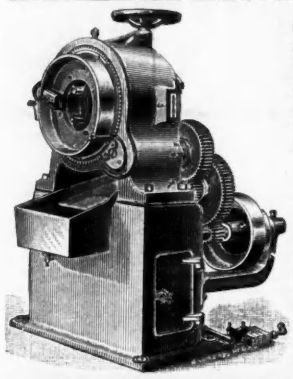

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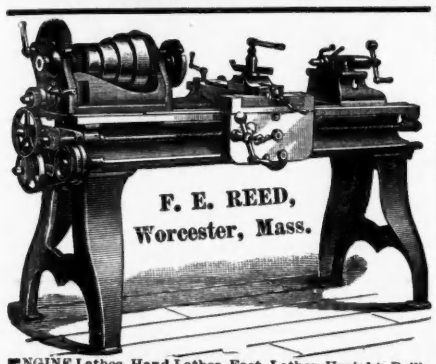

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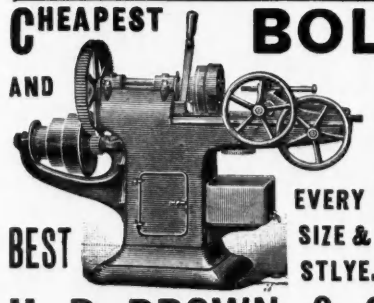

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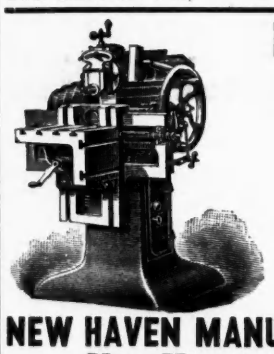

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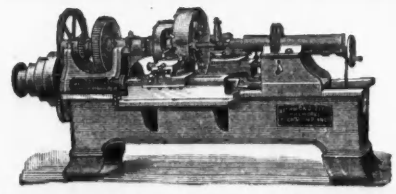

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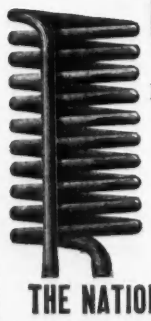

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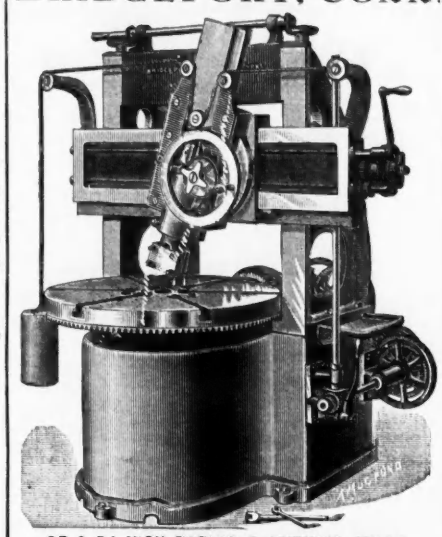

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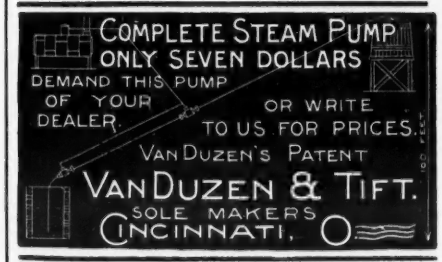

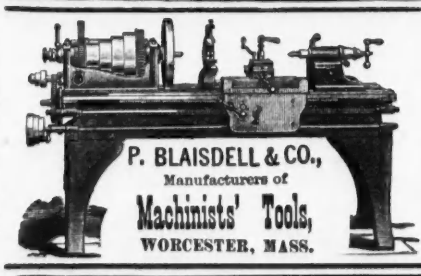

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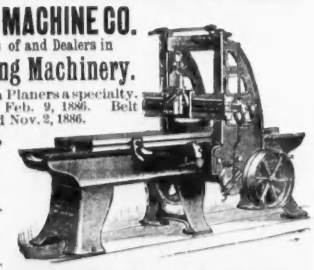

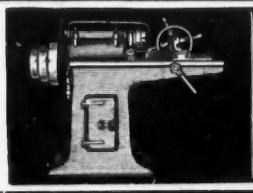

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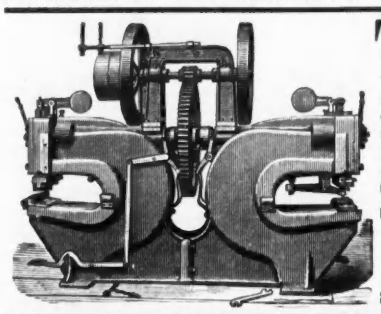

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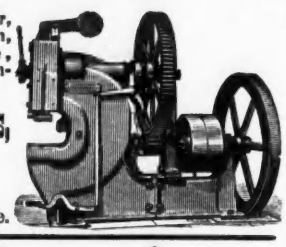

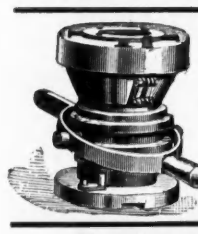

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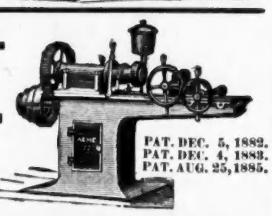

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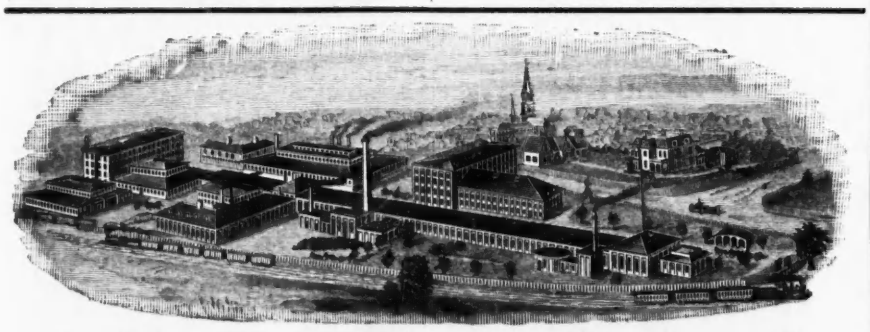

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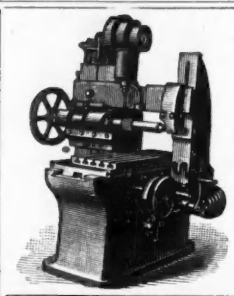

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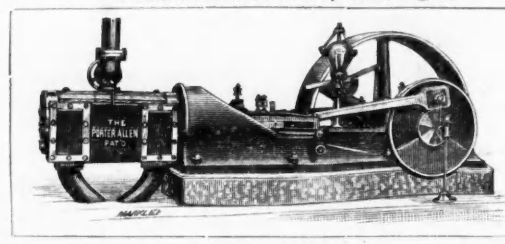

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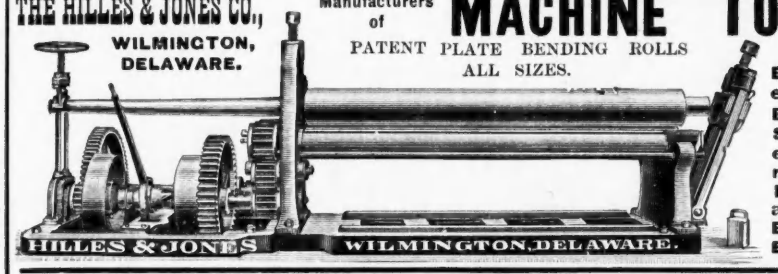

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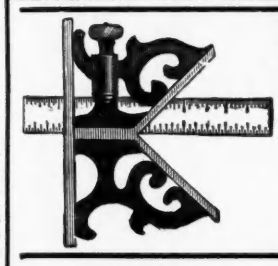

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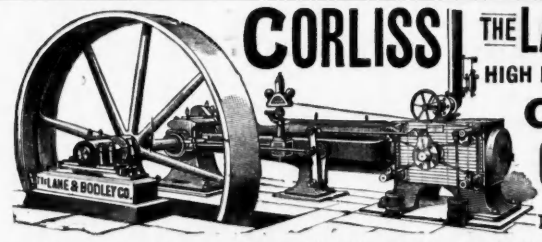

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1	16 in. x6 ft.	" "	Hendey,	new.
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1	16 in. x8 ft.	" "	Hendey,	new.
1	17 in. x8 ft.	" "	Fitchburg,	good.
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1	20 in. x10 ft.	" "	Fitchburg,	A 1.
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1	24 in. x10 ft.	" "	Fitchburg,	A 1.
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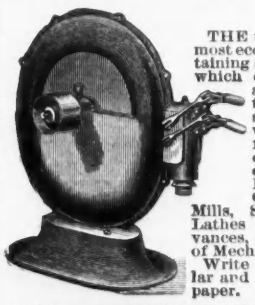

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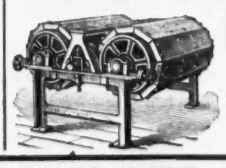

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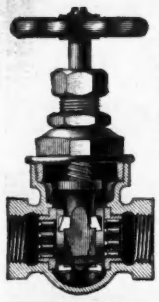

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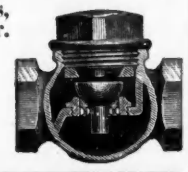

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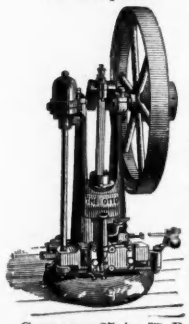

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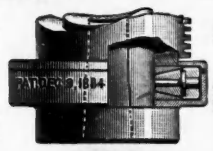

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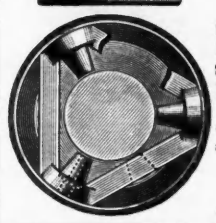

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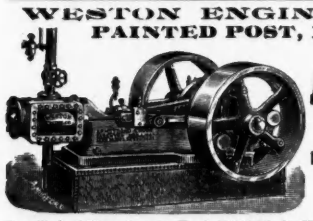

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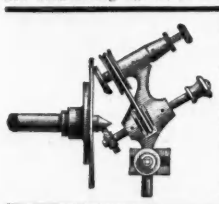

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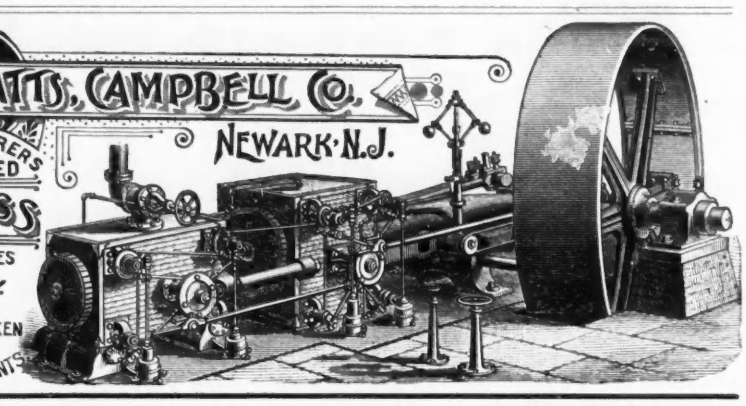

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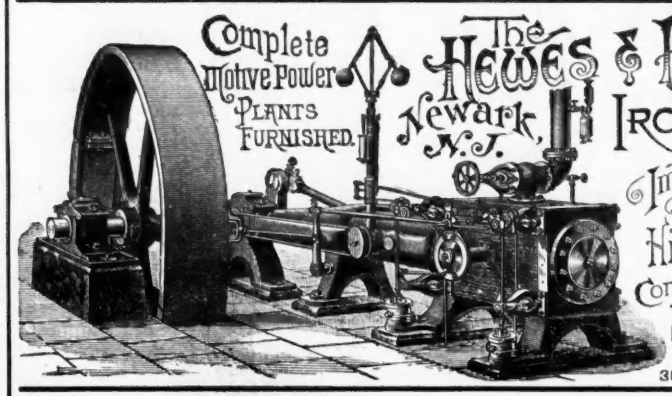

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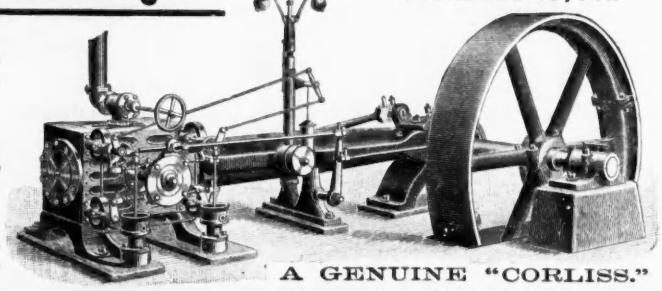

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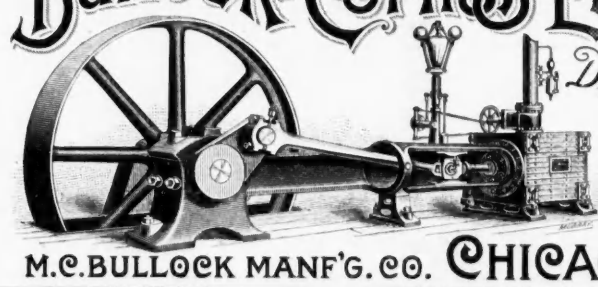

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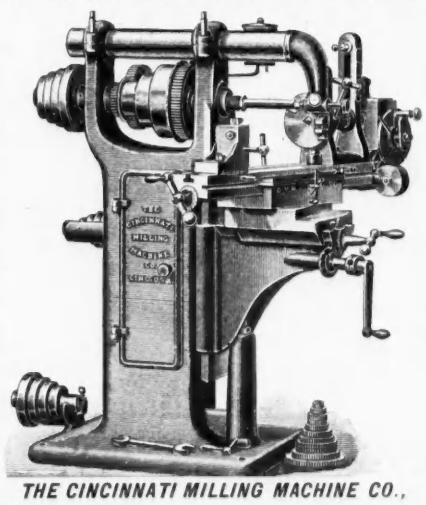

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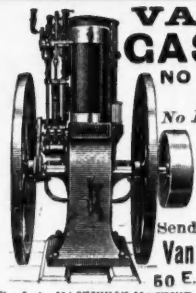

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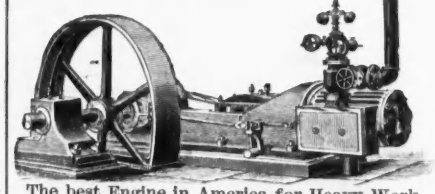

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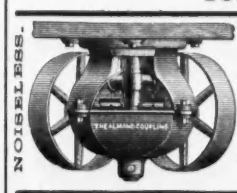

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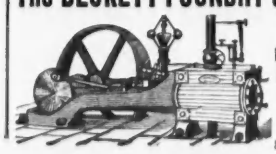

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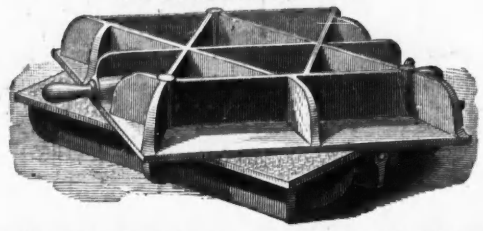

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4½ × 6″	"	5 "	9 × 14″	"	27 "	18 × 24″	"	128 "
6 × 6″	"	7 "	10 × 15″	"	35 "	18 × 36″	"	228 "
6 × 12″	"	19 "	10 × 30″	"	99 "	20 × 78″	"	813 "
6 × 50″	"	120 "	12 × 12″	"	29 "	24 × 24″	"	164 "
6½ × 18″	"	30 "	12 × 18″	"	53 "	24 × 36″	"	298 "
7 × 7½″	"	11 "	14 × 14″	"	47 "	24 × 48″	"	442 "
7 × 10″	"	15 "	14 × 18″	"	62 "	24 × 60″	"	666 "
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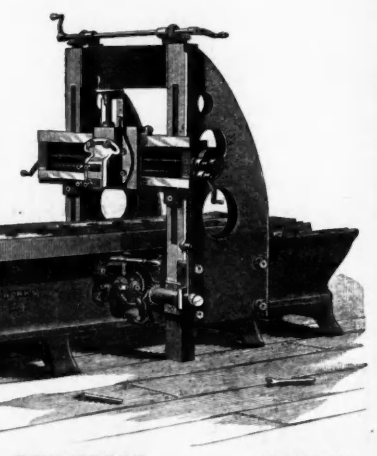

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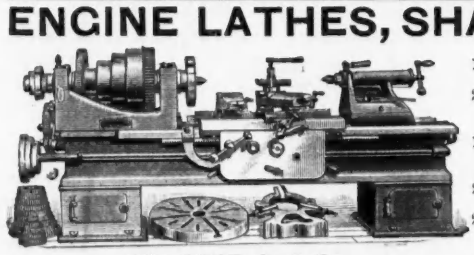

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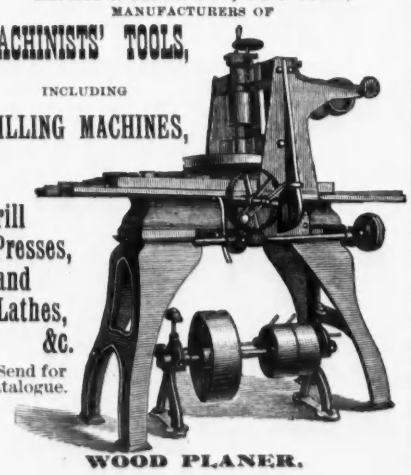

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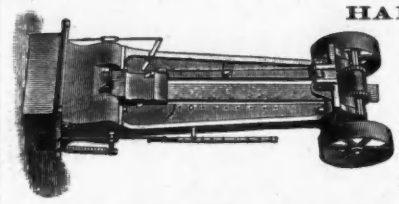

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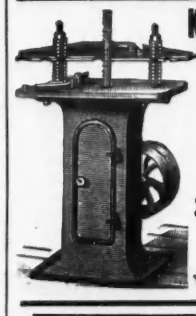

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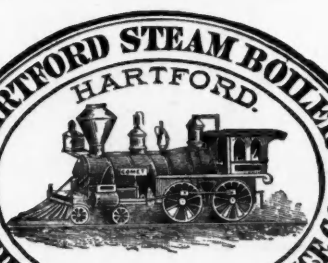

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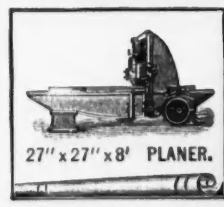

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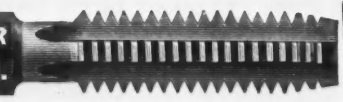

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